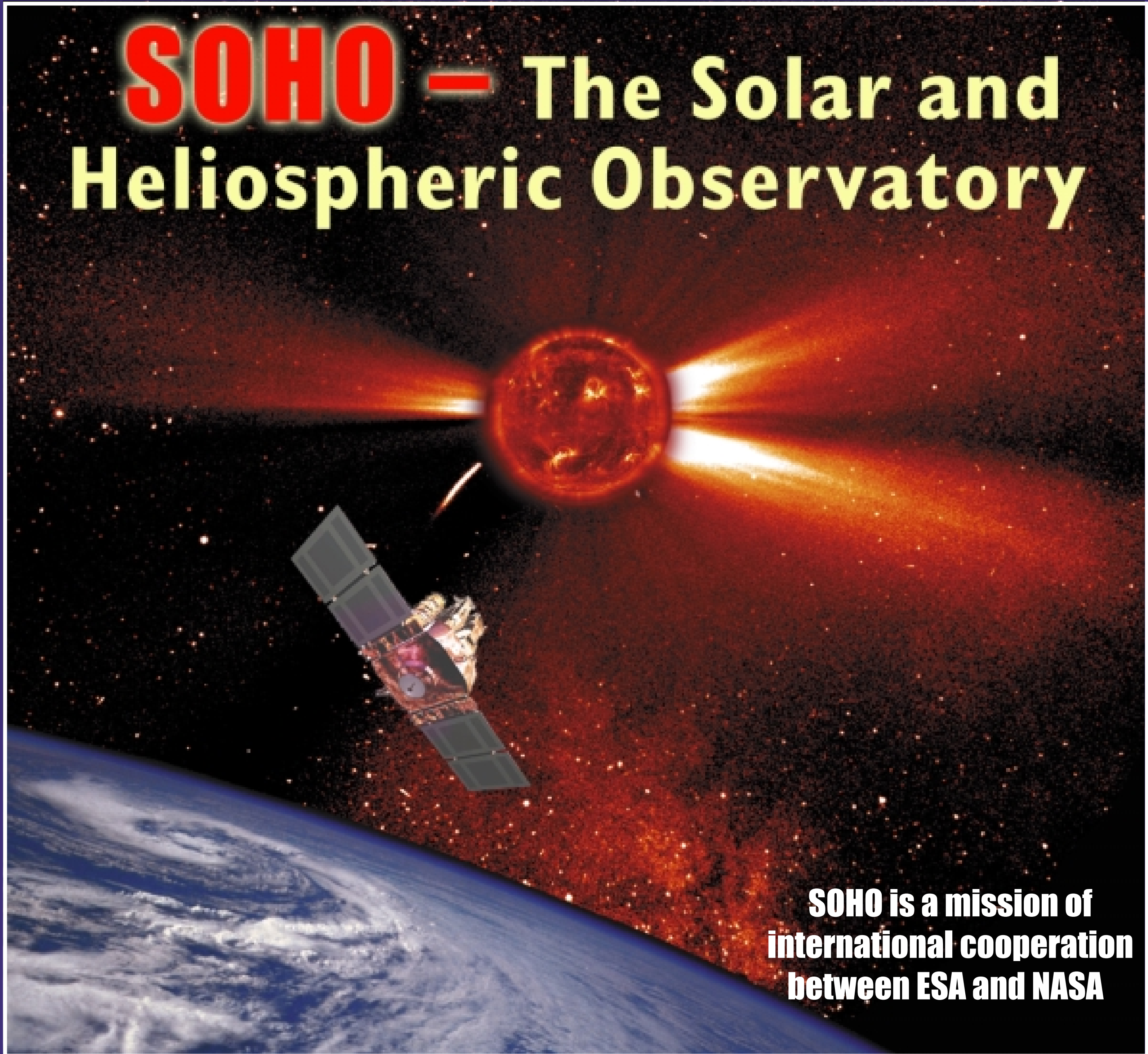
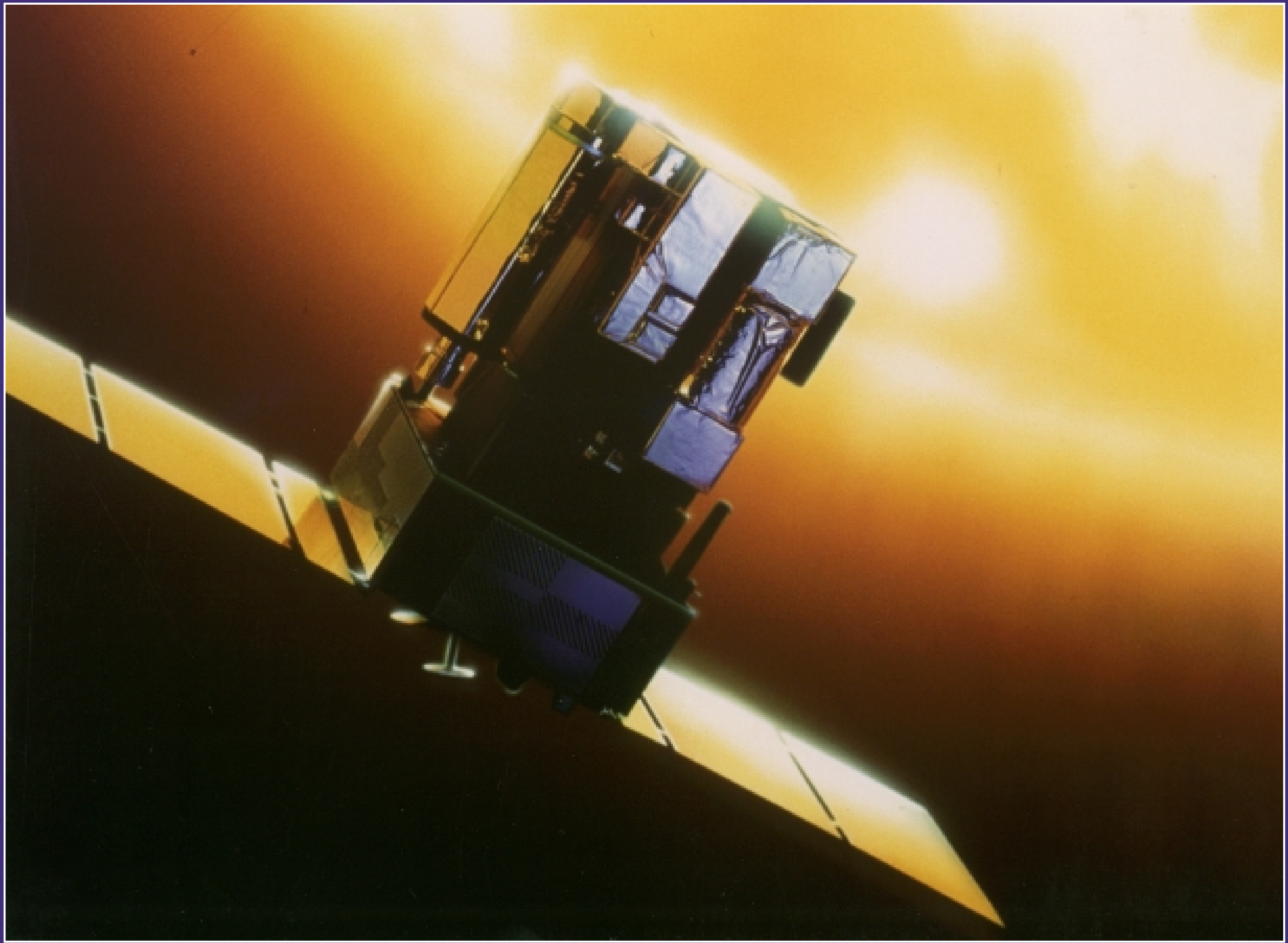
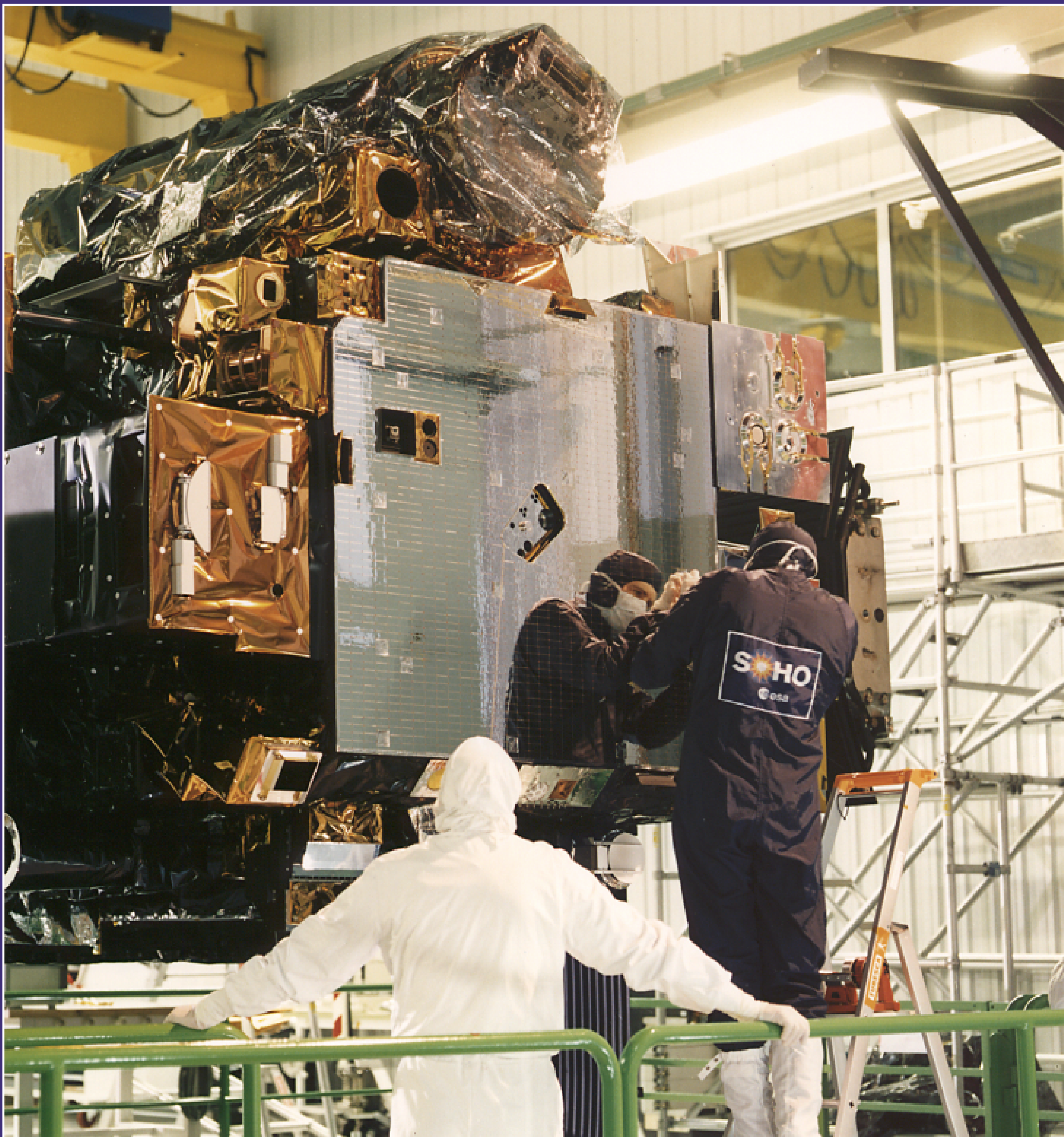

SOHO – The Solar and Heliospheric Observatory
SOHO is a mission of international cooperation between ESA and NASA



Artist’s rendition of the SOHO spacecraft



SOHO spacecraft being prepared for thermal tests at Intespace in Toulouse, France

SOHO payload module, without thermal blankets, at the end of its integration and testing at Matra Marconi Space

The SOHO Spacecraft

1 **SUMER**: Solar Ultraviolet Measurements of Emitted Radiation

2 **CDS**: Coronal Diagnostic Spectrometer

3 **EIT**: Extreme-ultraviolet Imaging Telescope

4 **UVCS**: UltraViolet Coronagraph Spectrometer

5 **LASCO**: Large-Angle and Spectrometric COronagraph

6 **SWAN**: Solar Wind ANisotropies

11 **MDI**: Michelson Doppler Imager

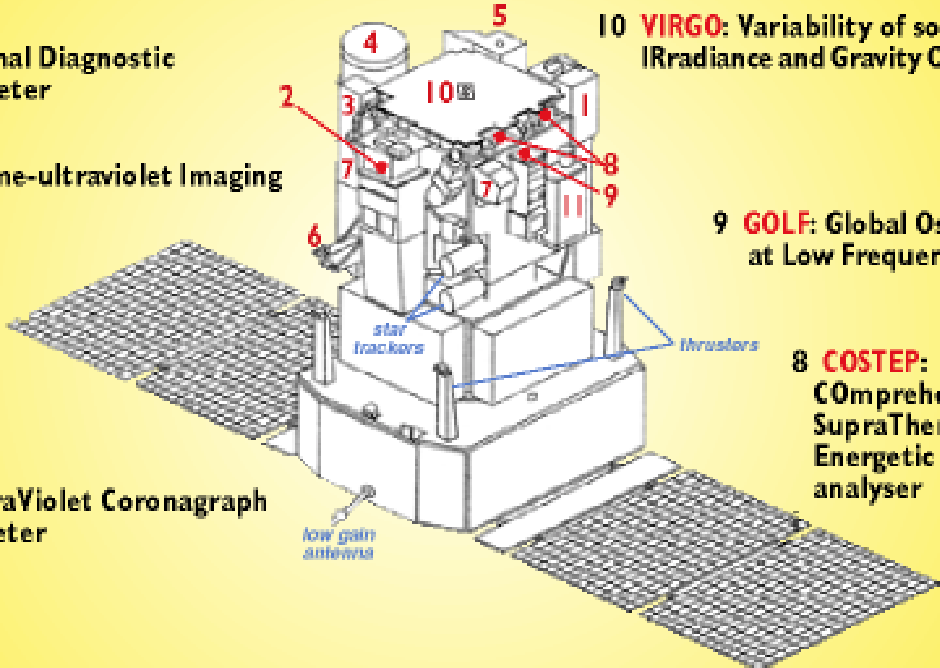
10 **VIRGO**: Variability of solar IRradiance and Gravity Oscillations

9 **GOLF**: Global Oscillations at Low Frequencies

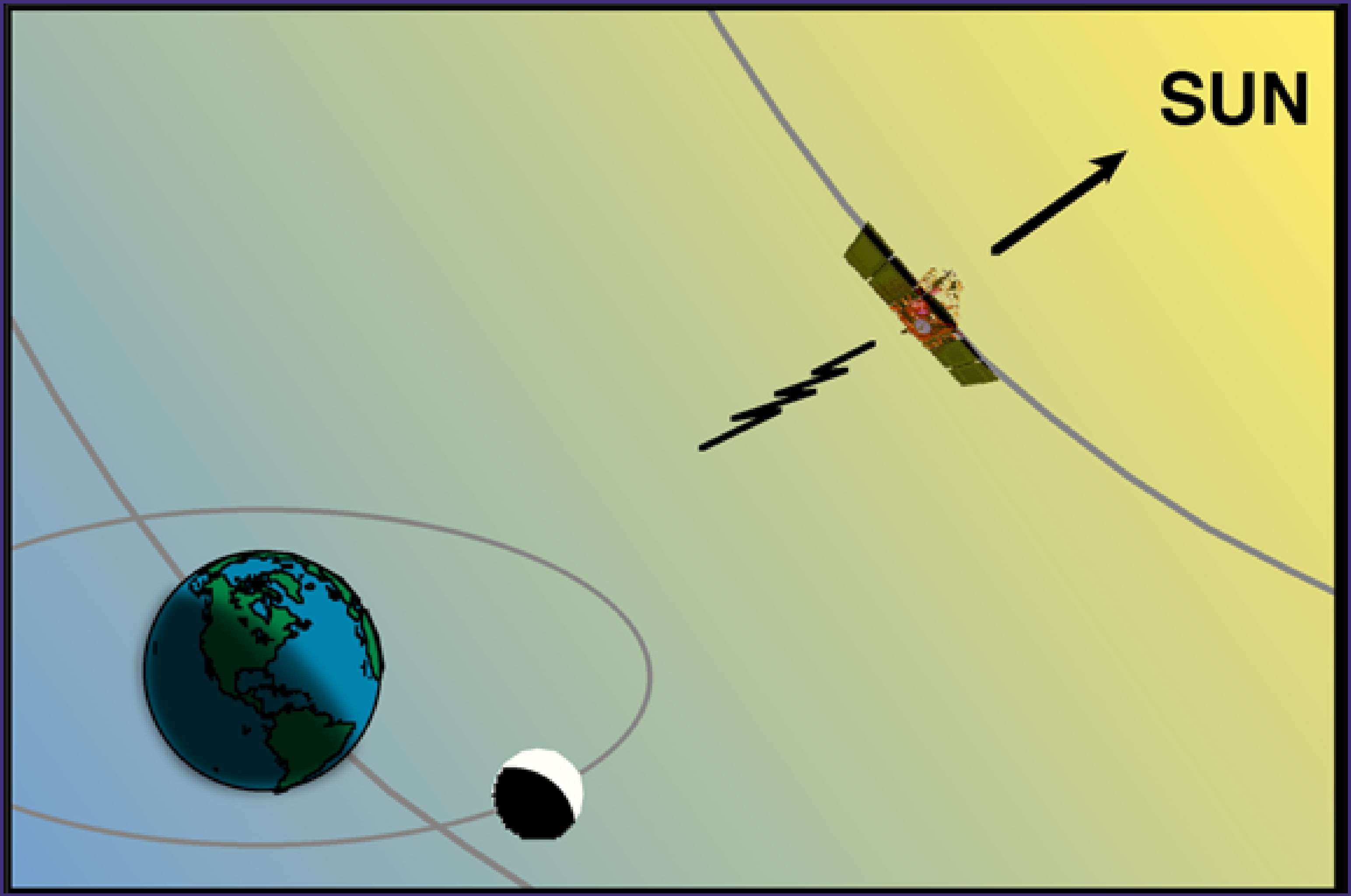
8 **COSTEP**: COmprehensive SupraThermal and Energetic Particle analyser

7 **CELIAS**: Charge, ELement and Isotope Analysis System

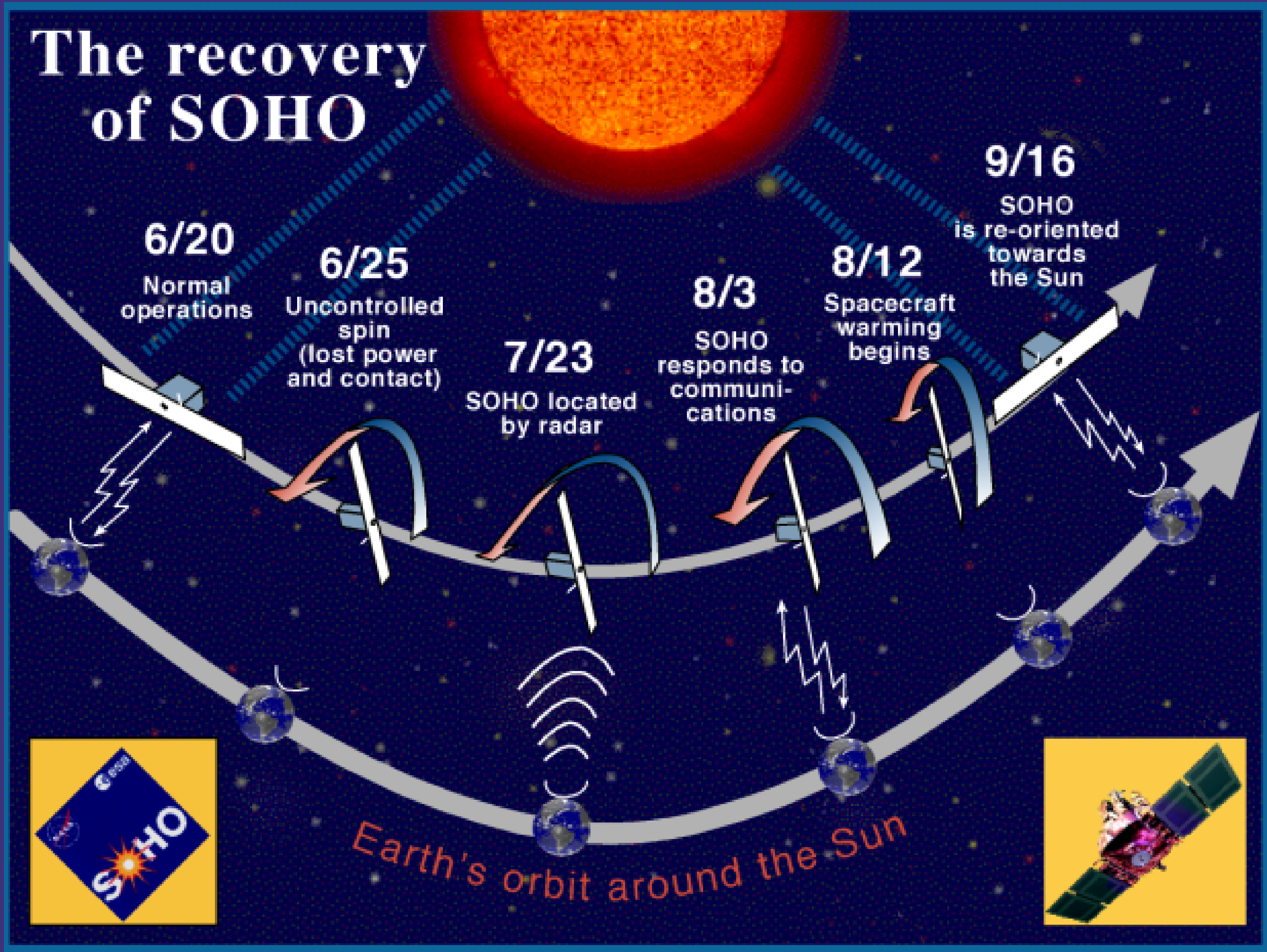
8 **ERNE**: Energetic and Relativistic Nuclei and Electron experiment



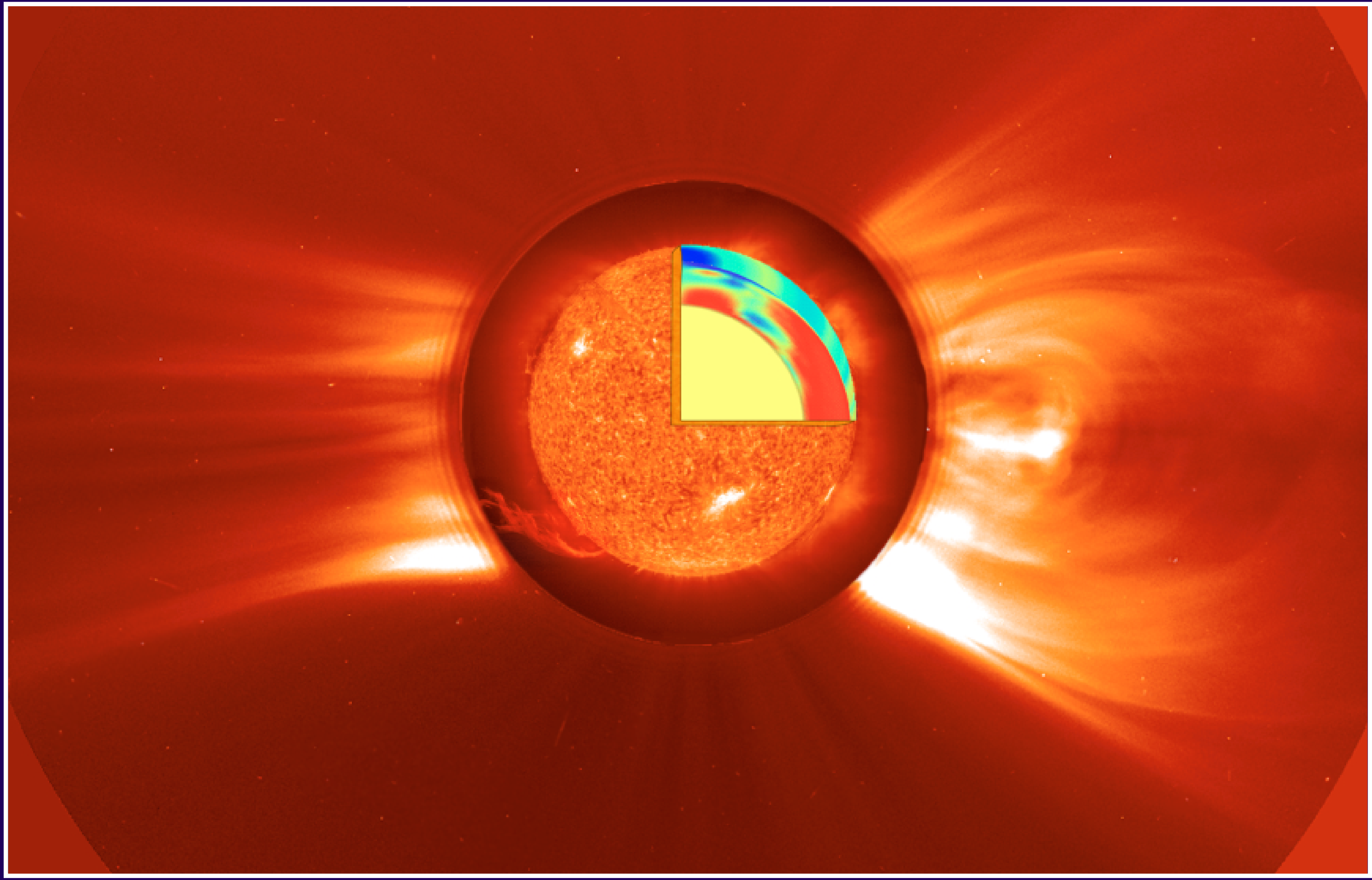
SOHO, a solar scientific observatory, has 12 instruments on board to observe the Sun 24 hours a day. It is a mission of international cooperation between ESA and NASA.



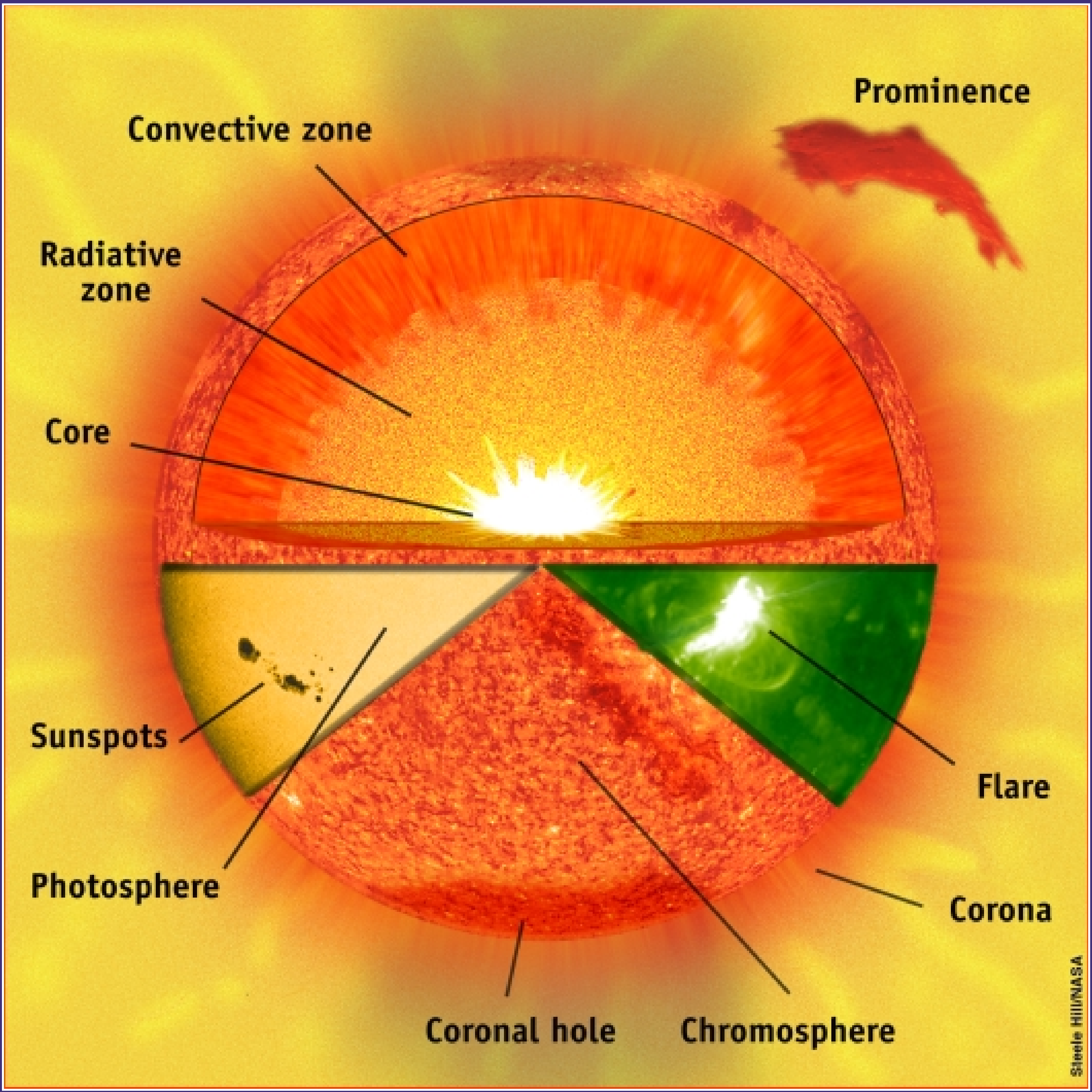
Schematic of SOHO's orbital path in relation to the Earth, moon, and Sun – SOHO is about 1.5M km sunward of the Earth



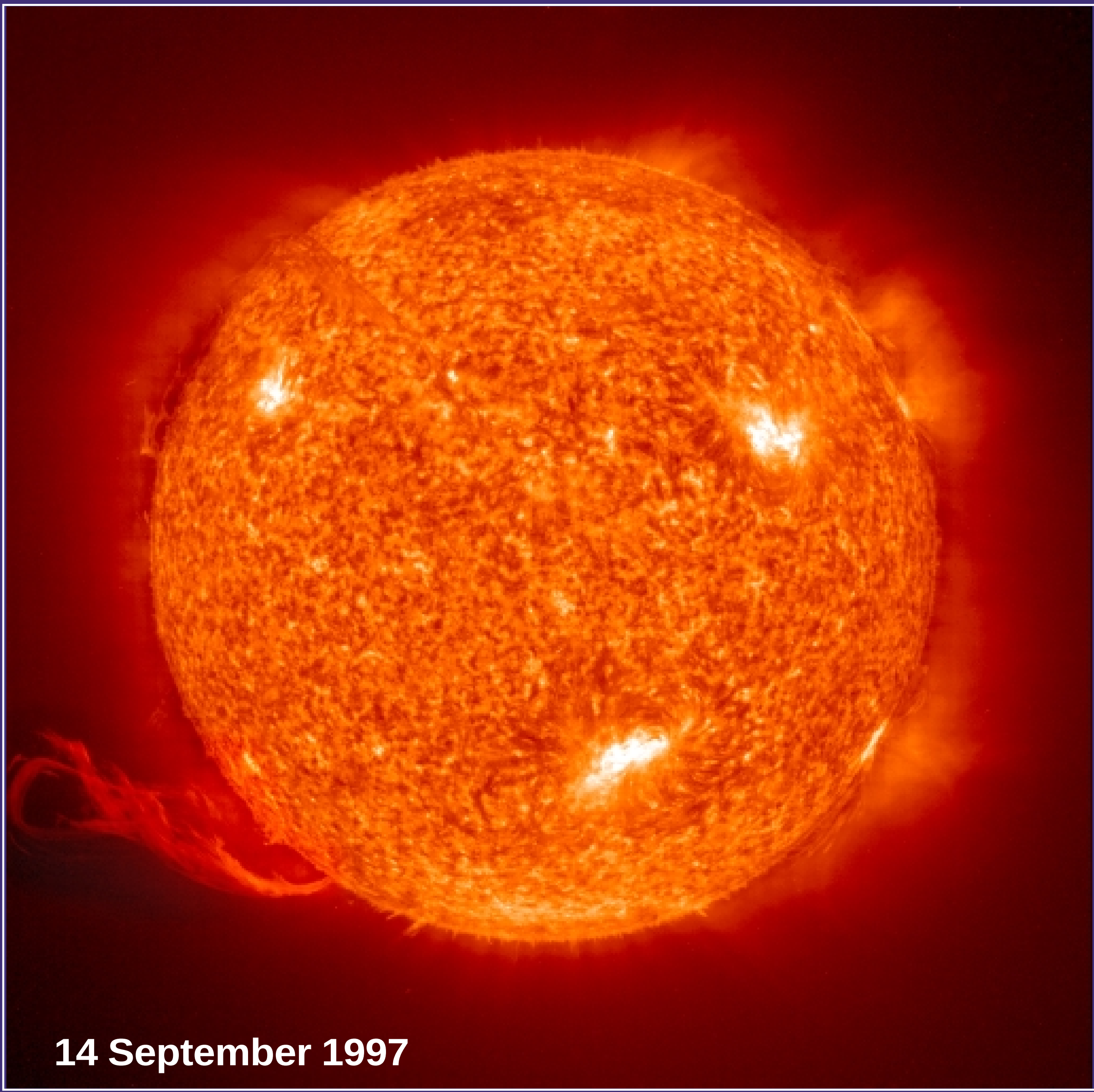
Ground operations lost contact with SOHO on 24 June 1998, but through diligent efforts the recovery team was able to nurse SOHO back to life by November 1998



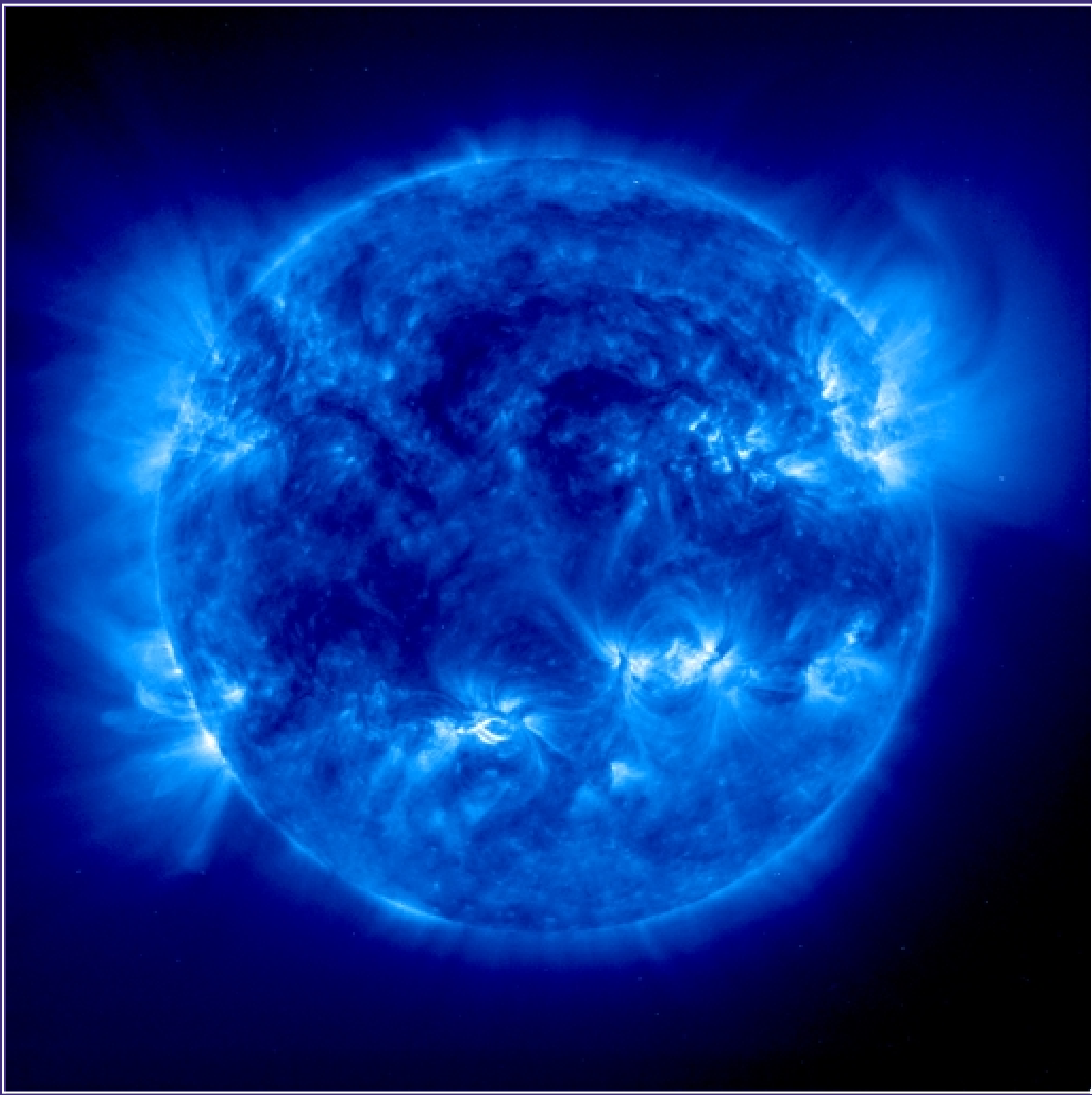
A composite image of the Sun that depicts the range of SOHO’s scientific research from the solar interior, to the surface and corona, and out to the solar wind



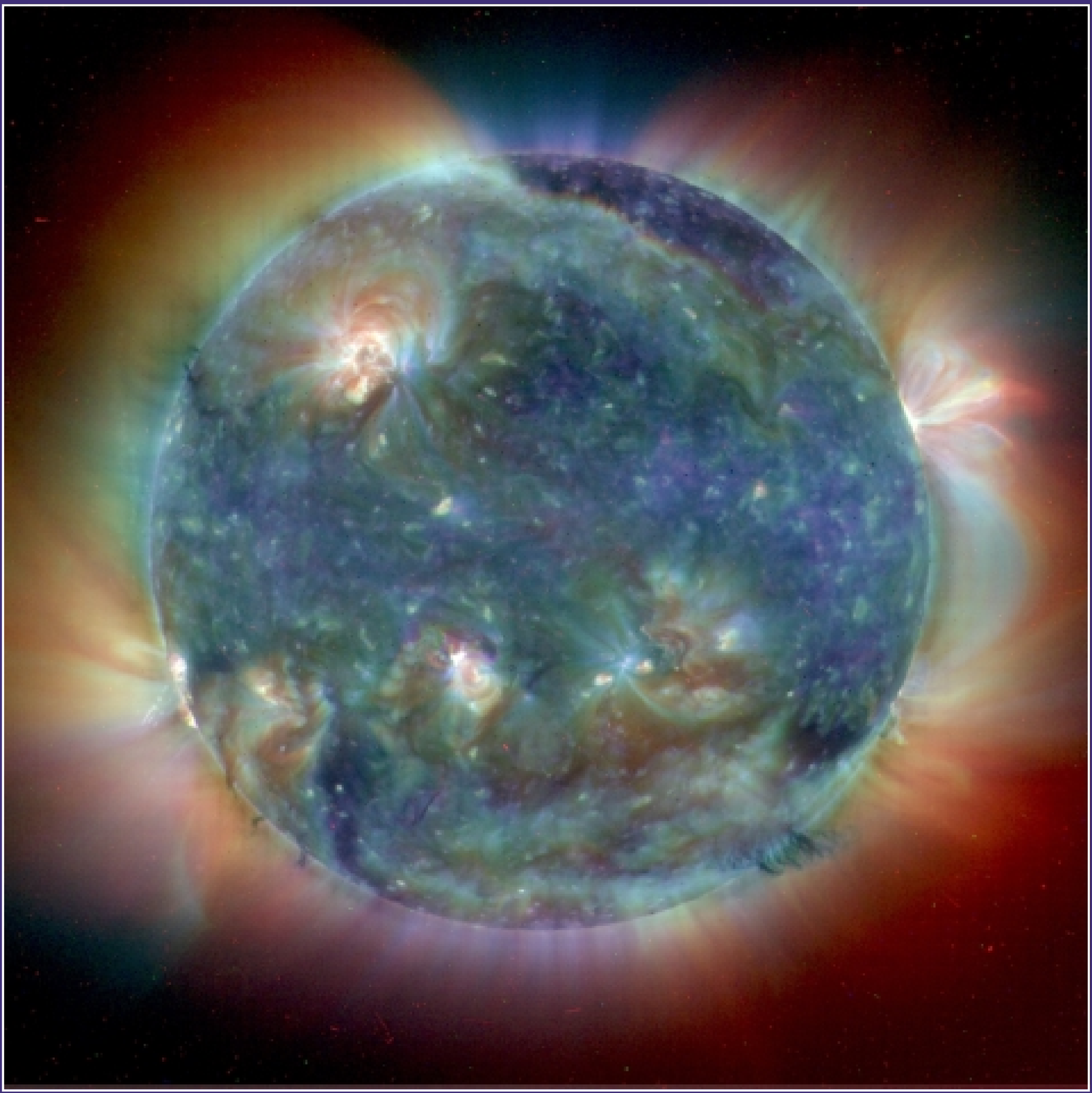
The parts of the Sun



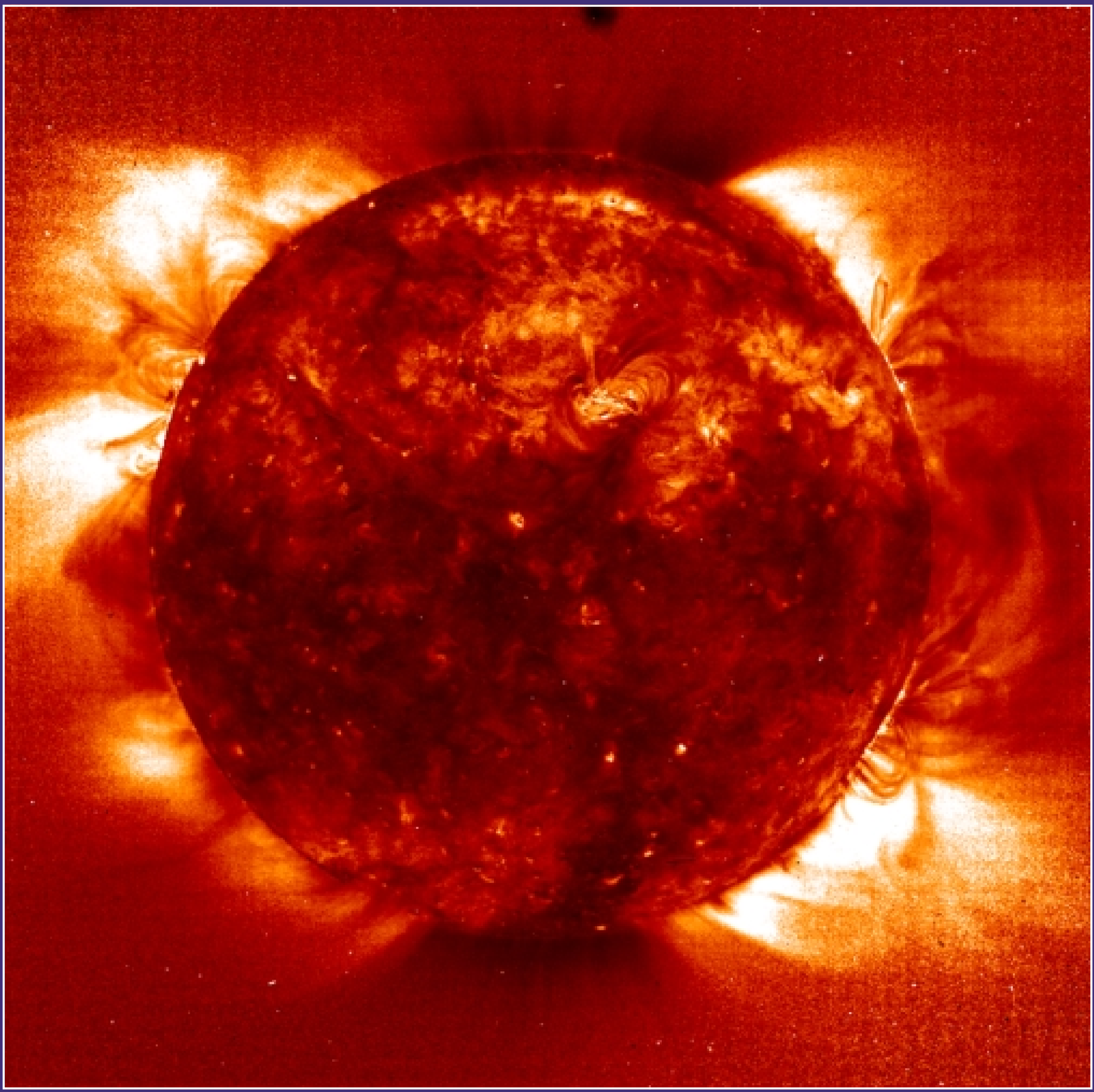
Erupting prominence as recorded by EIT in the He II 304Å line



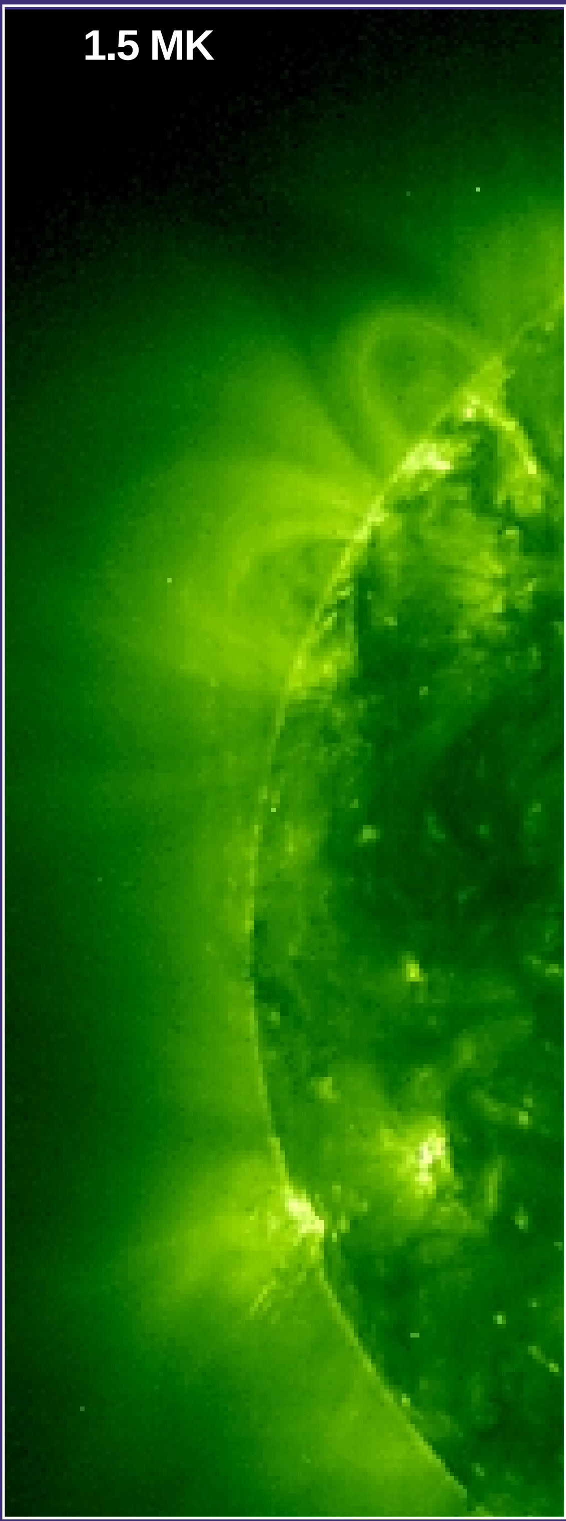
Active regions and magnetic loops as recorded by EIT in the Fe IX/X 171Å line

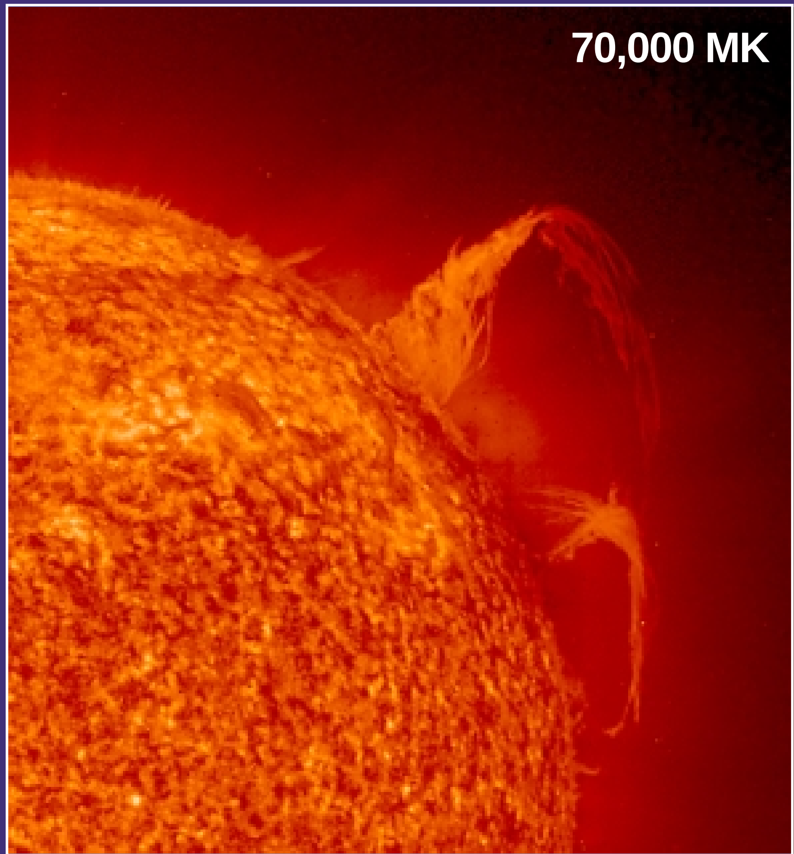


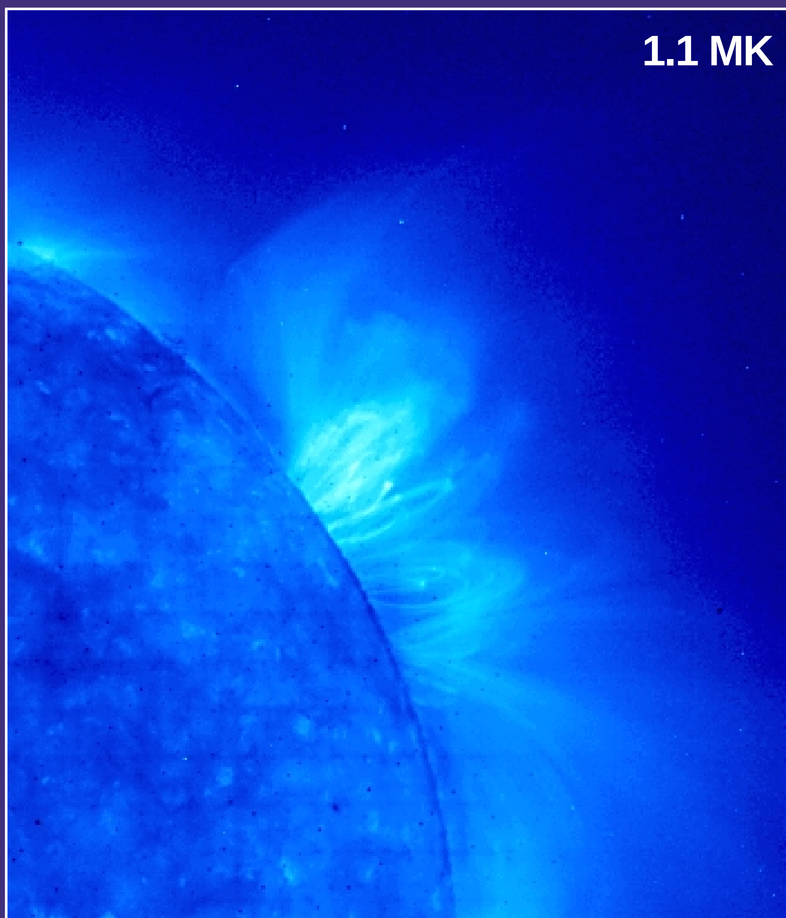
EIT composite image from three wavelengths (171Å, 195Å and 284Å) revealing solar features unqiue to each wavelength



Ratio of EIT full Sun images in Fe XII 195Å to Fe IX/X 171Å – Bright areas are hotter; dark areas are cooler

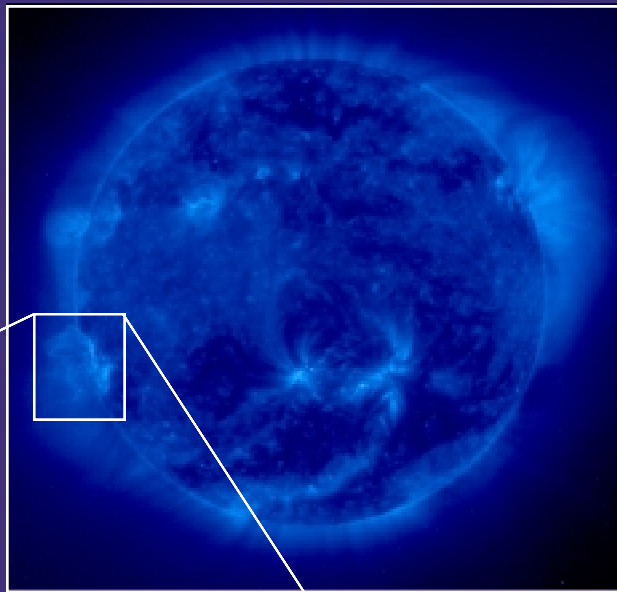


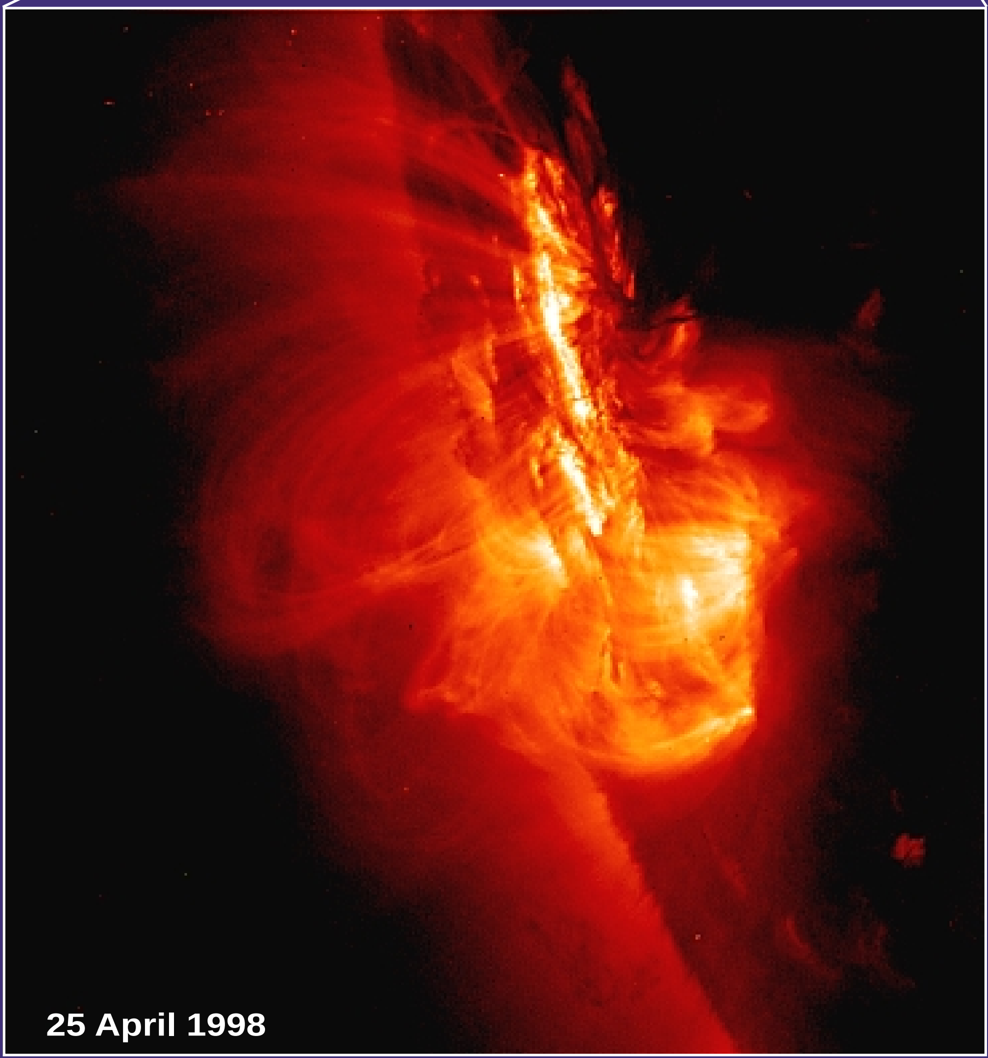




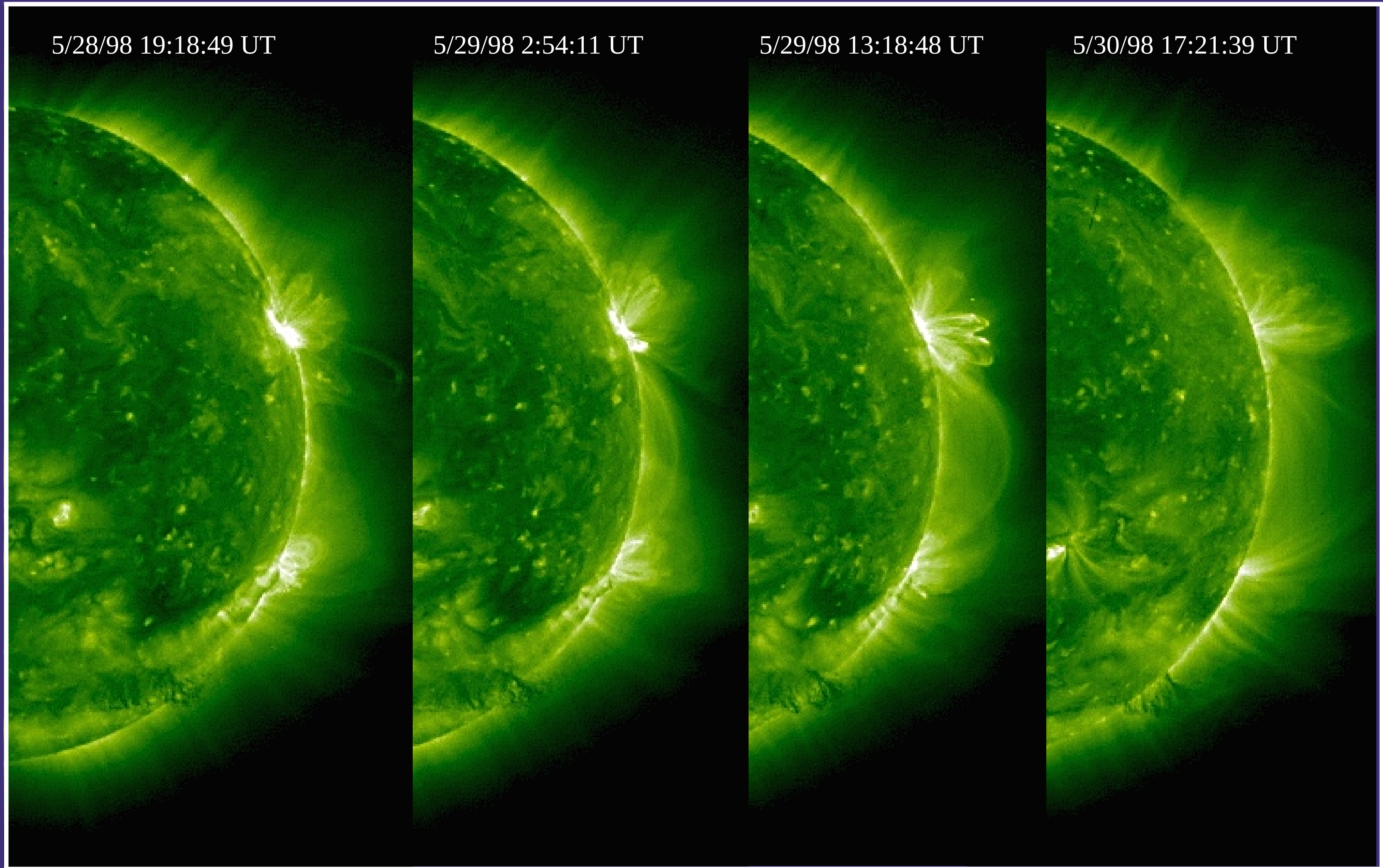
Magnetic loops and prominences captured by the Extreme ultraviolet Imaging Telescope (EIT) in three wavelengths

EIT 171 full disk image



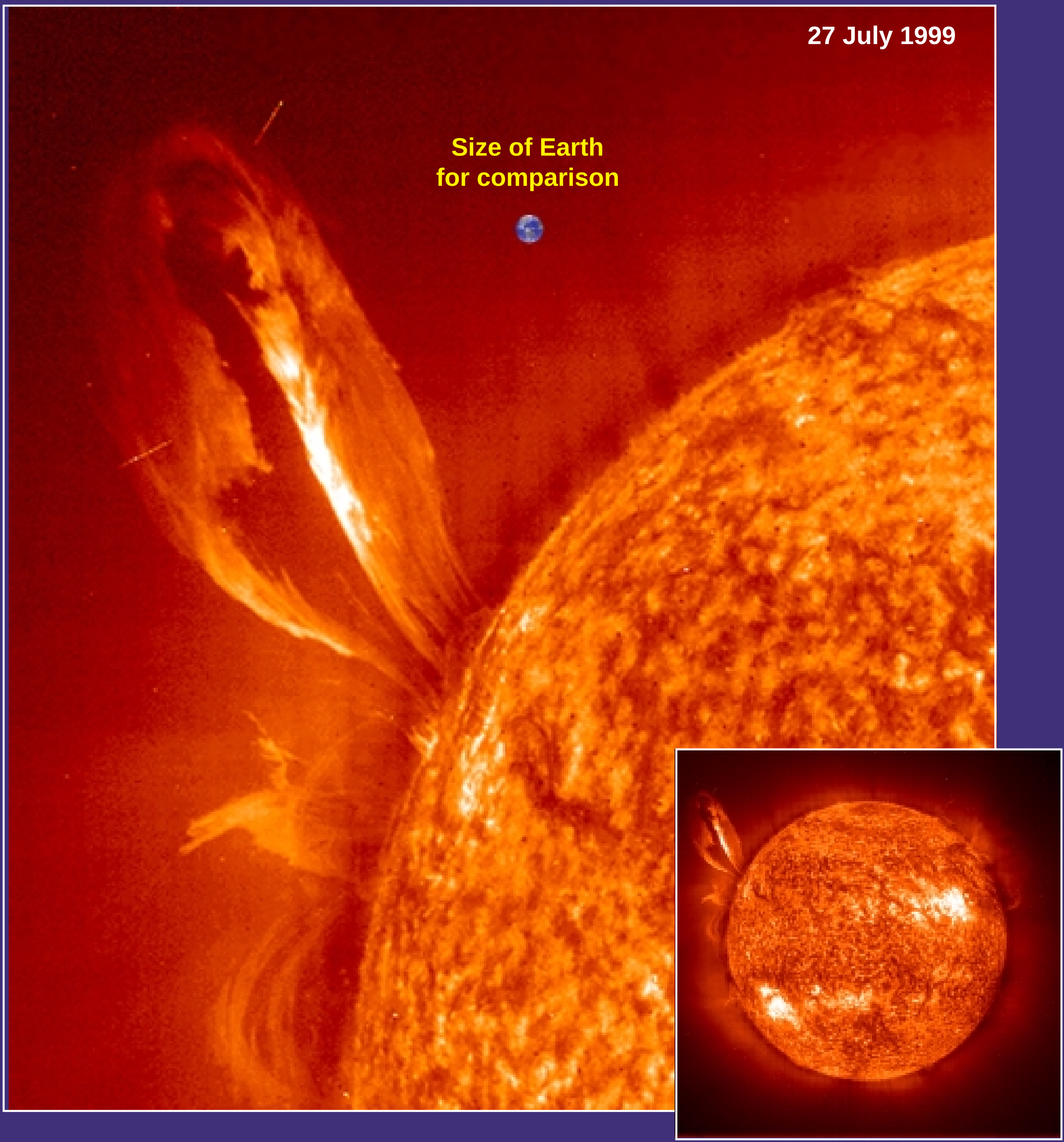


Close-up of an active region in extreme ultraviolet light from NASA’s TRACE (Transition Region and Coronal Explorer) spacecraft

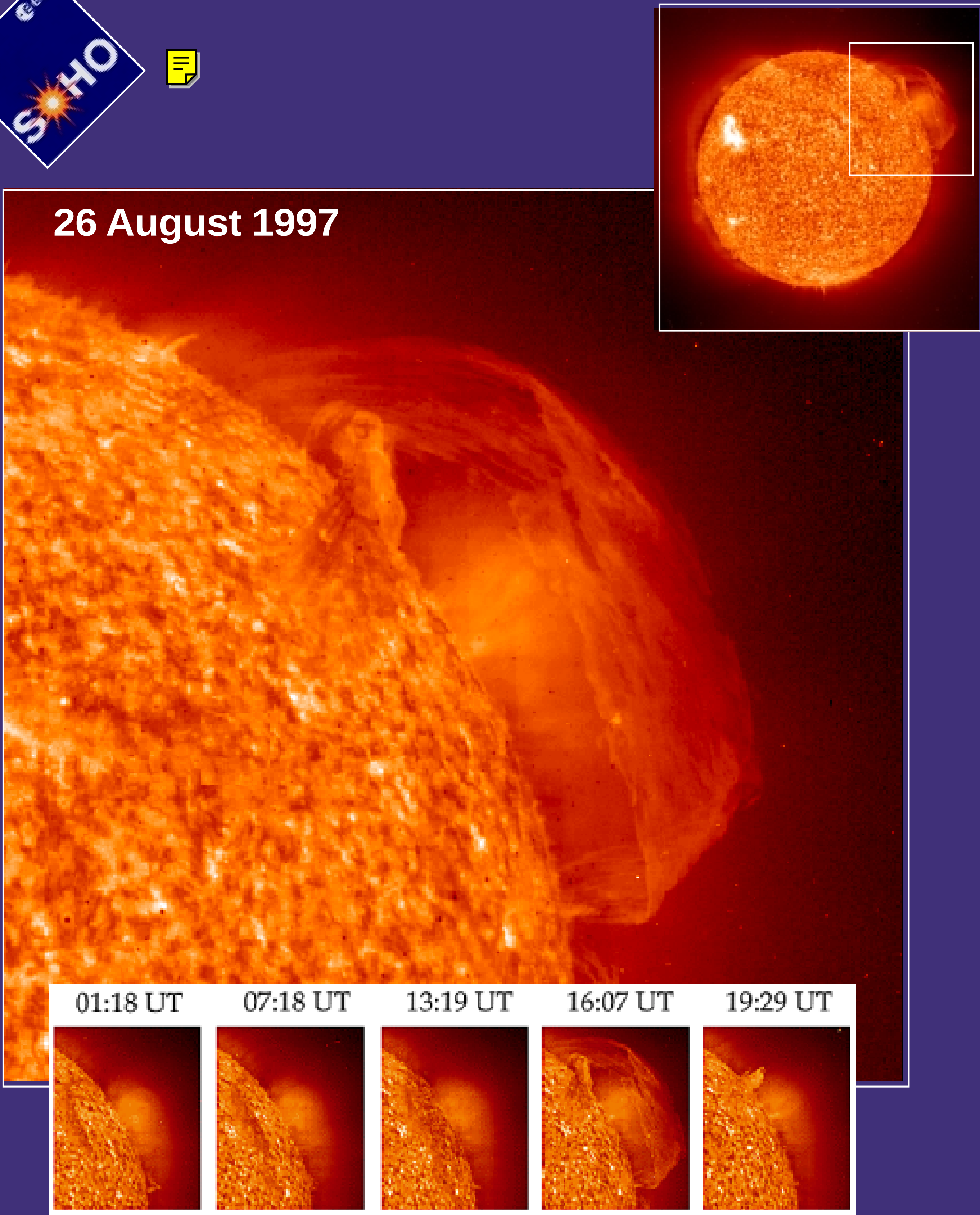


A series of EIT 195Å images over two days shows two active regions connecting their magnetic field lines over a large area of the Sun

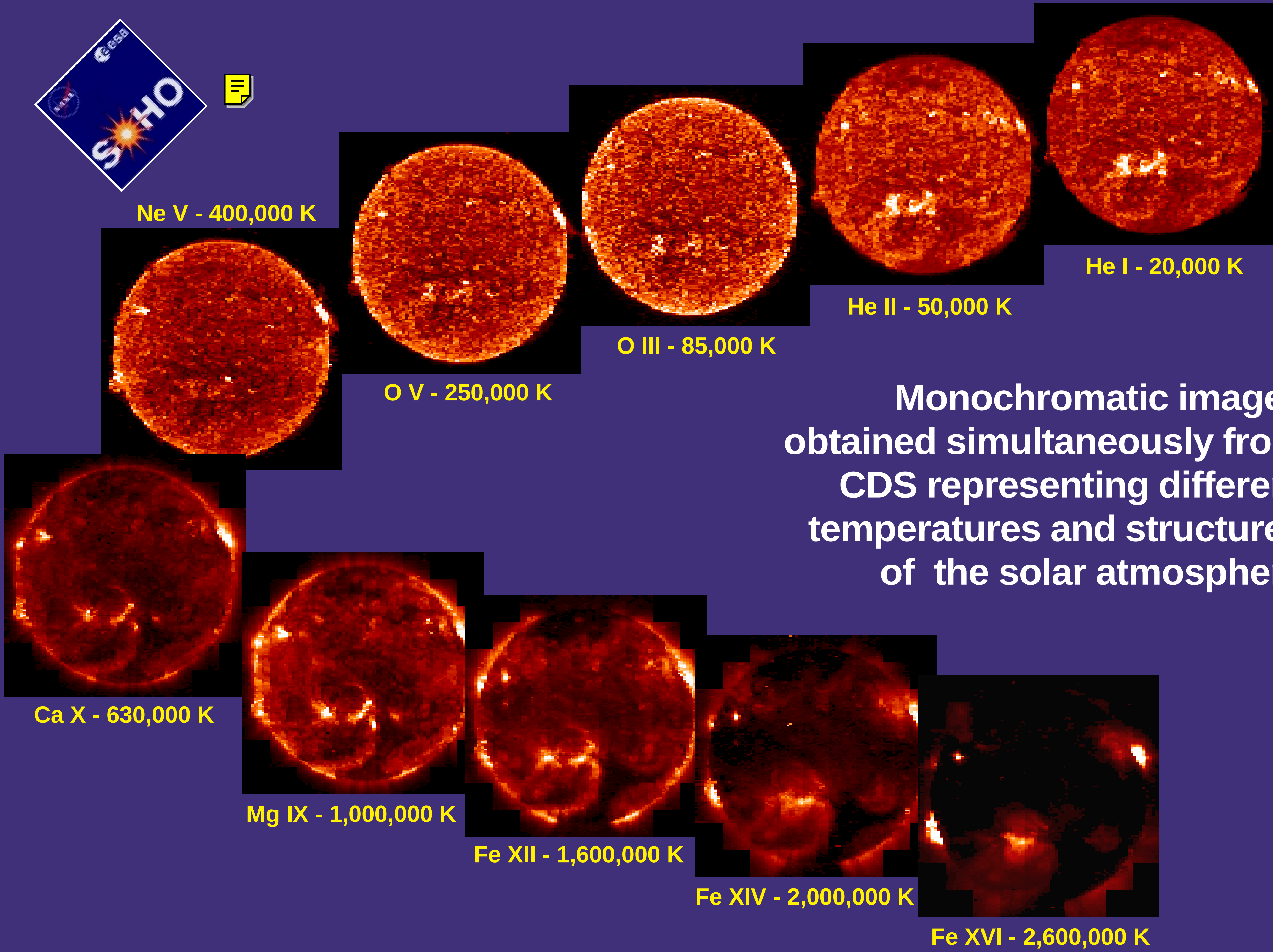
Images are Fe XII at 195Å showing the solar corona at a temperature of about 1.5 million K.



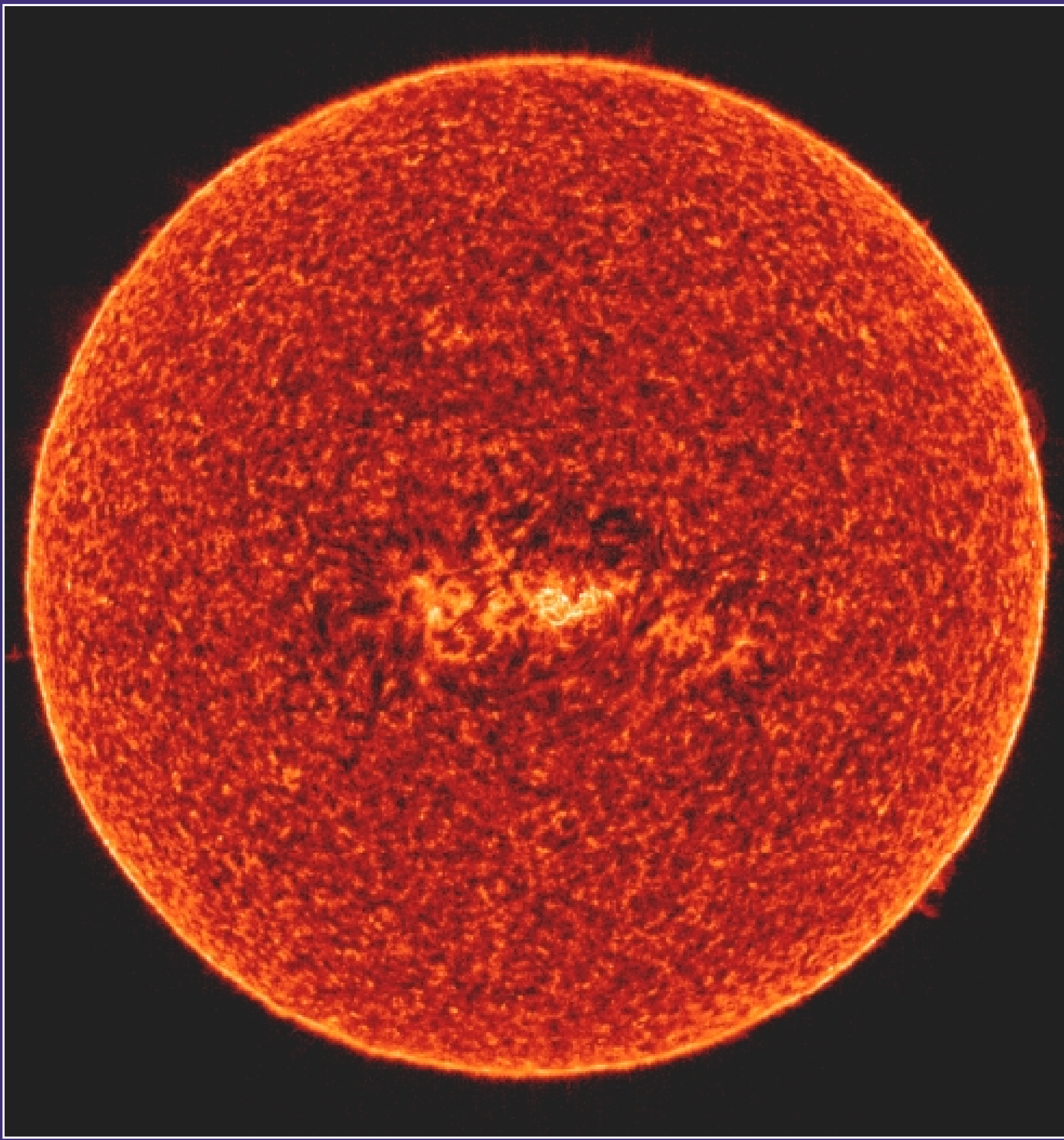
Large, eruptive prominence in He II at 304Å, with an image of the Earth added for size comparison



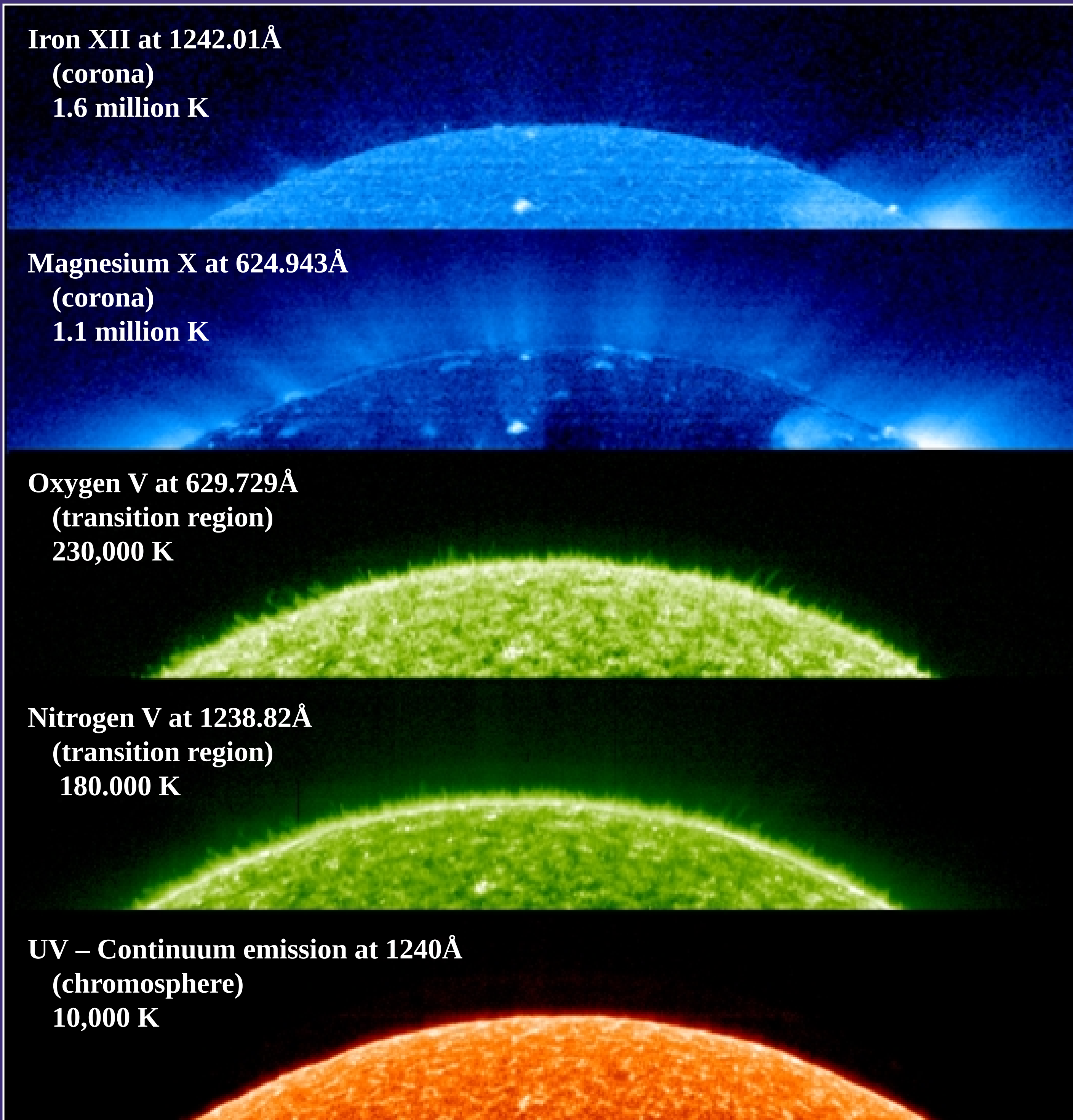
One of the largest eruptive prominences recorded by SOHO/EIT in 1997 in He II at 304Å.
It reached 28 times the size of Earth.



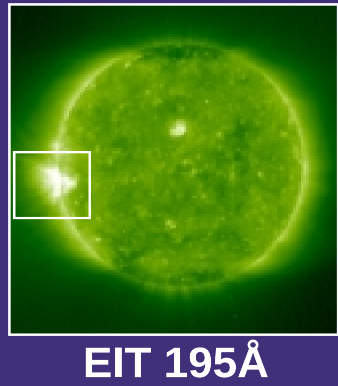
Monochromatic images obtained simultaneously from CDS representing different temperatures and structures of the solar atmosphere

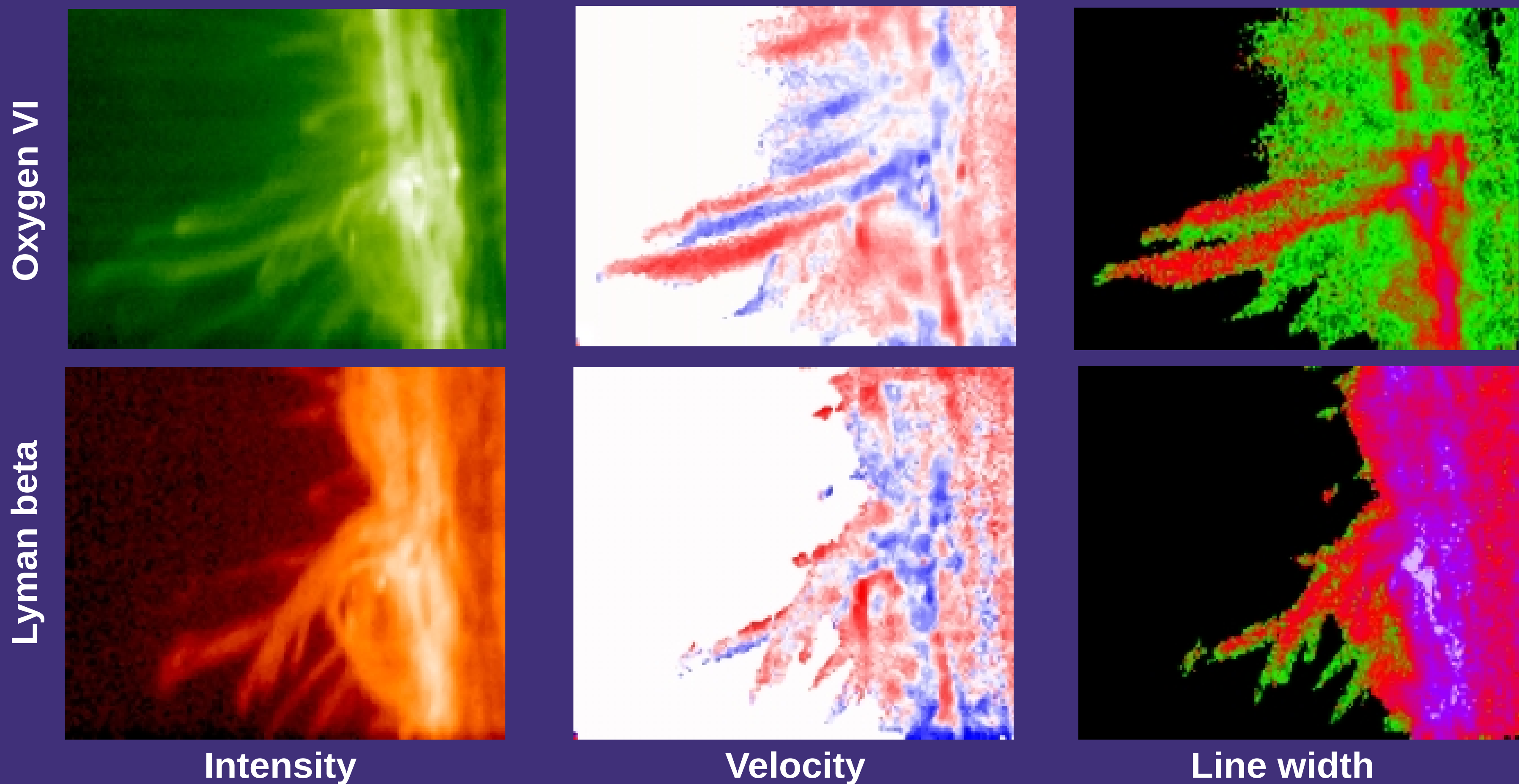


SUMER image in S VI at 933 Å on 12 May 1996

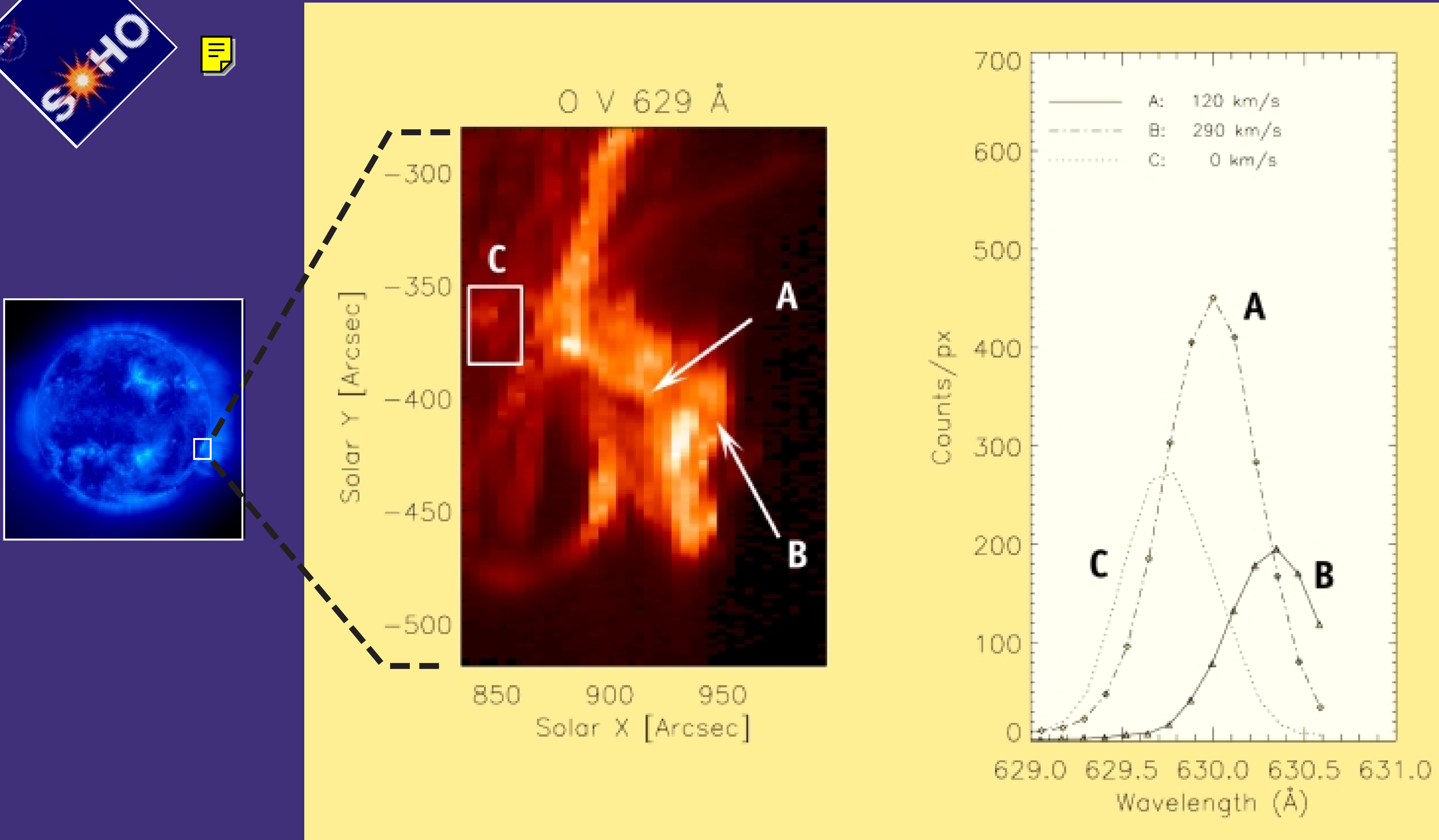


SUMER scans of a north polar coronal hole in lines formed at temperatures from 10,000 to 1.6 MK

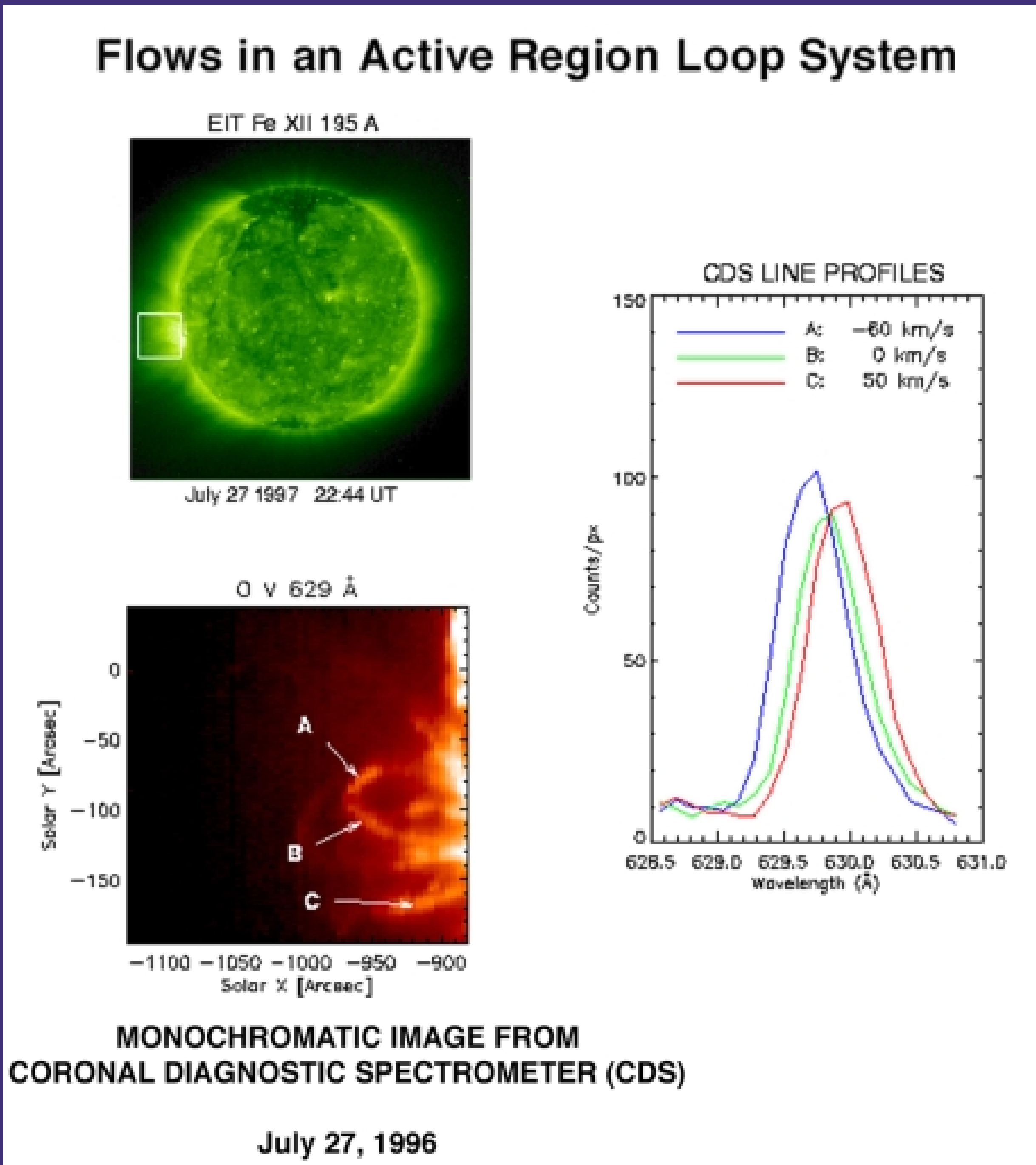




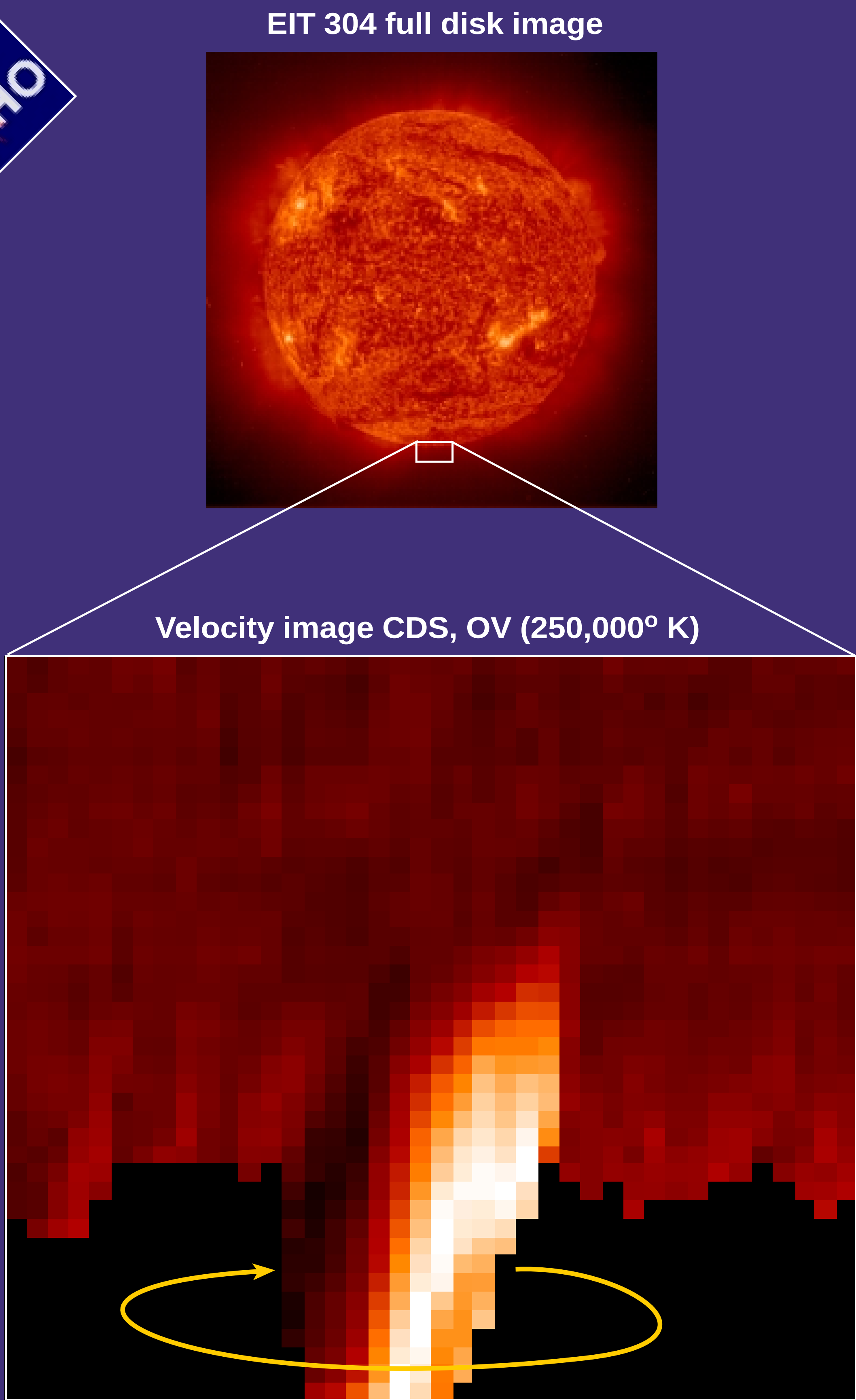
Simultaneous imaging of UV emission, gas flow velocities, and spectral line width of active region loop structures observed with SUMER



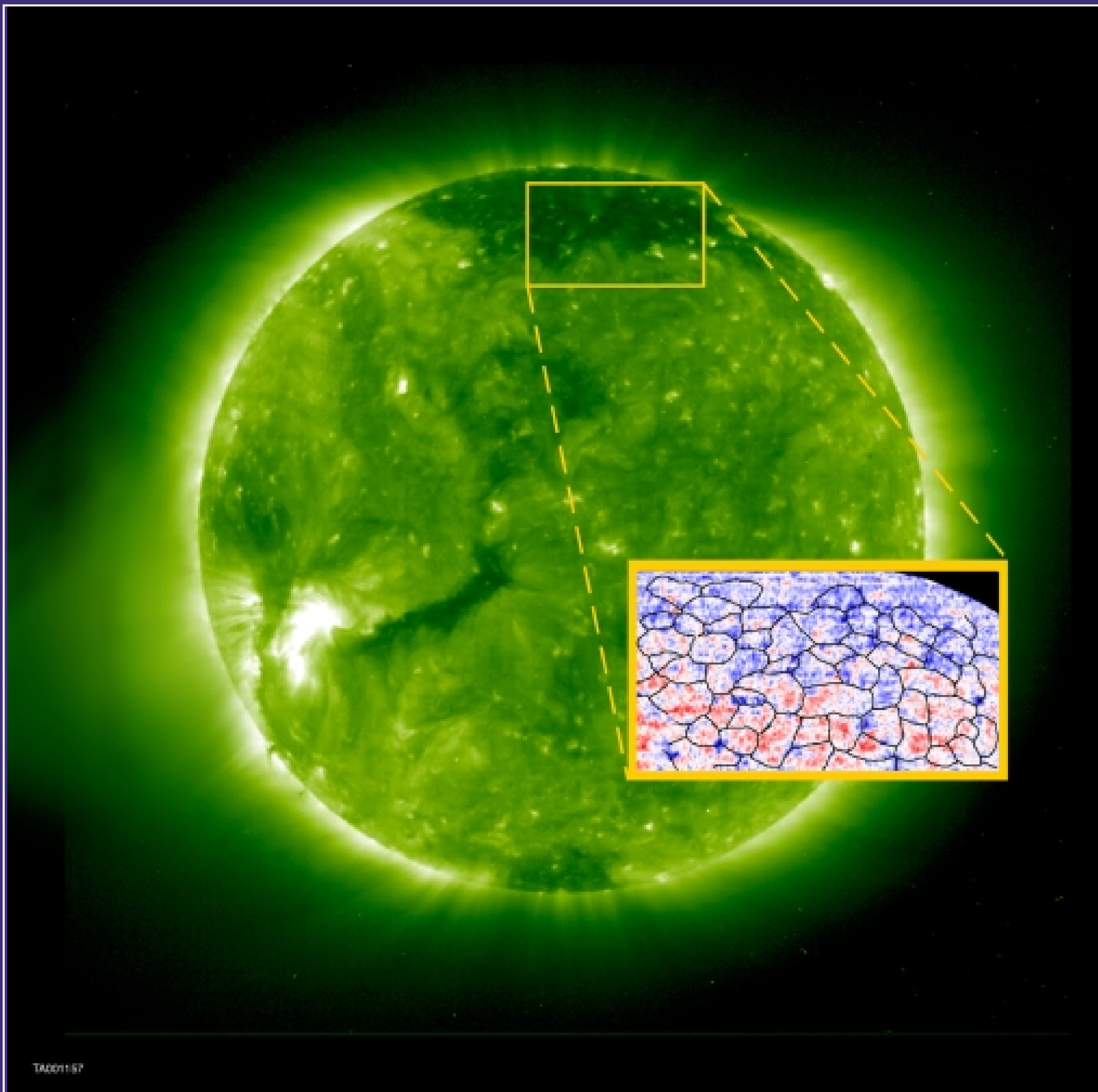
Supersonic flow velocities observed by CDS during a solar eruption from the south west limb. The velocities approach 300 km/s at the leading edge (B).



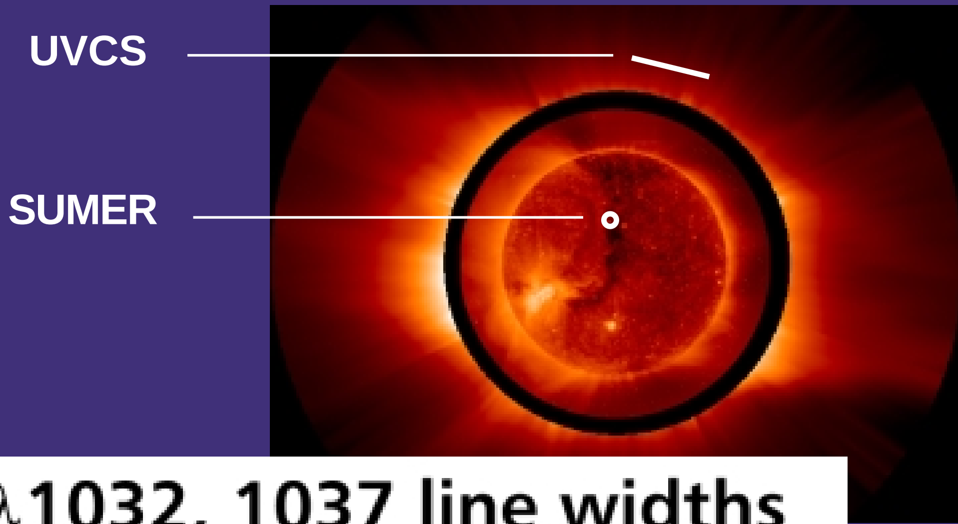
Active region loop system above the east limb observed in O V on 27 July 1996 by CDS. The line profiles from three different spatial locations (A, B, and C) are displayed in the right panel.

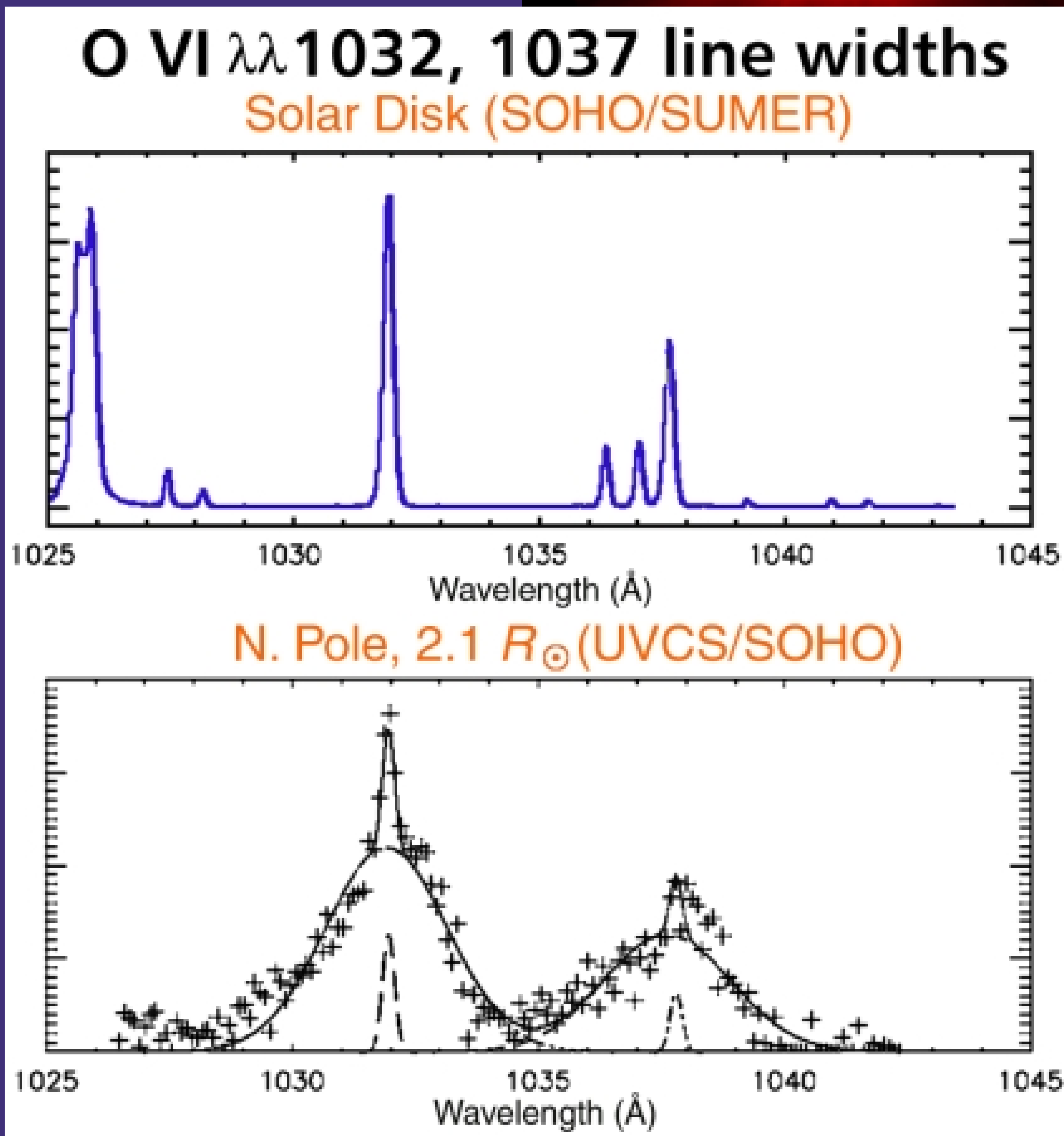


Solar “tornado” observed by SOHO/CDS with speeds up to 500,000 km/h

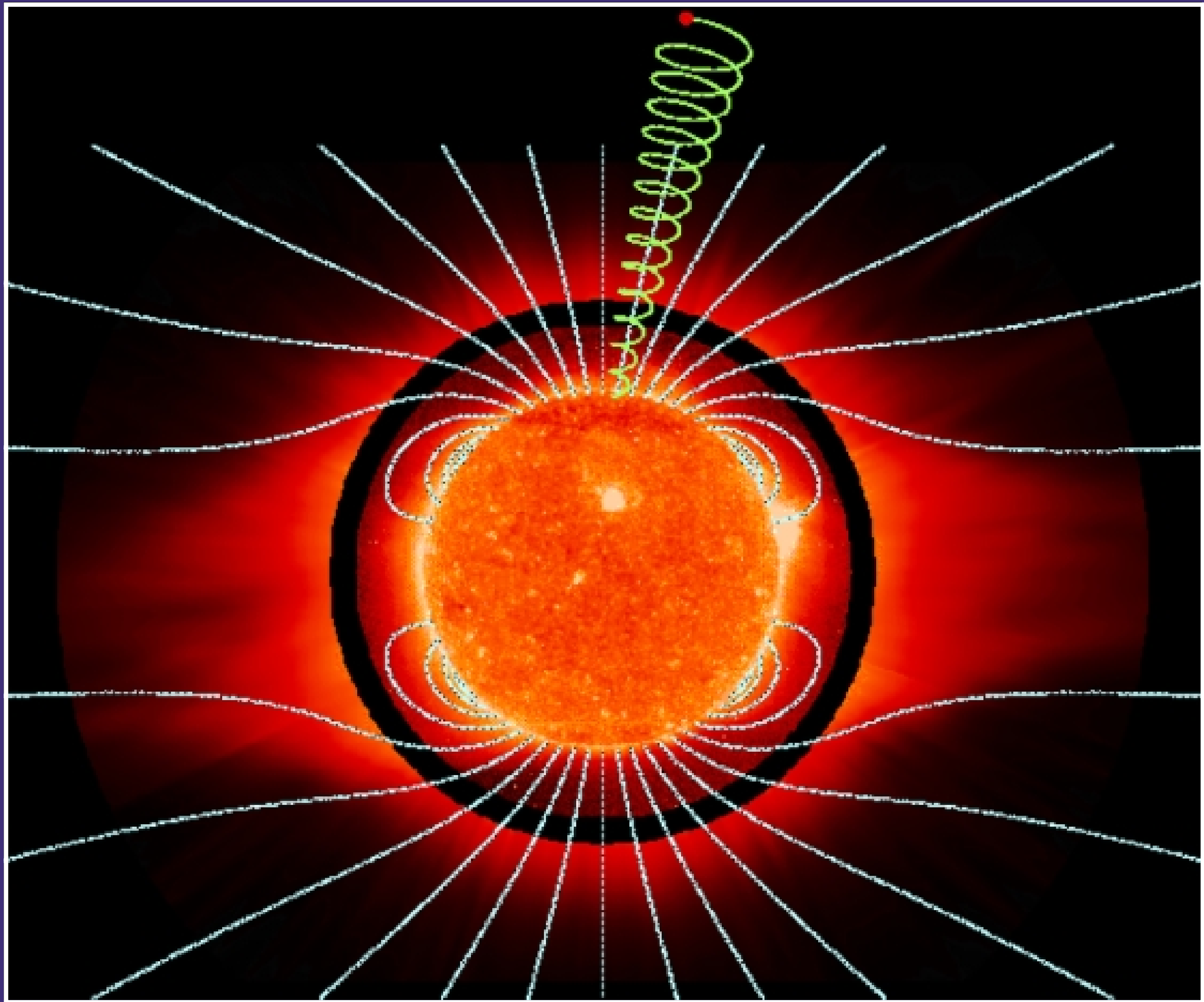


SUMER Doppler velocity map (close-up) of a polar coronal hole region showing the source regions of the fast solar wind. The strongest flows occur near the boundary intersections of the supergranular network cells.

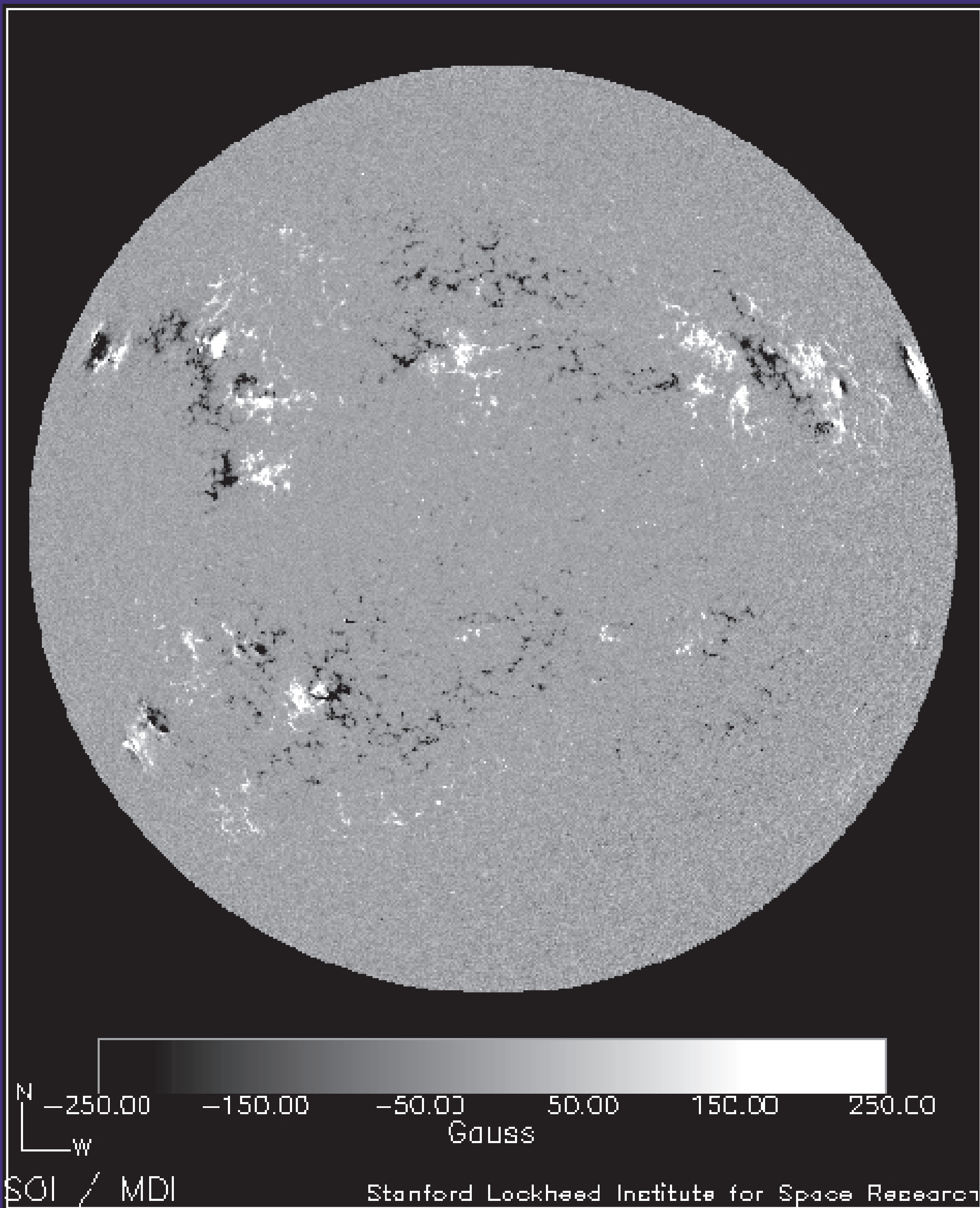




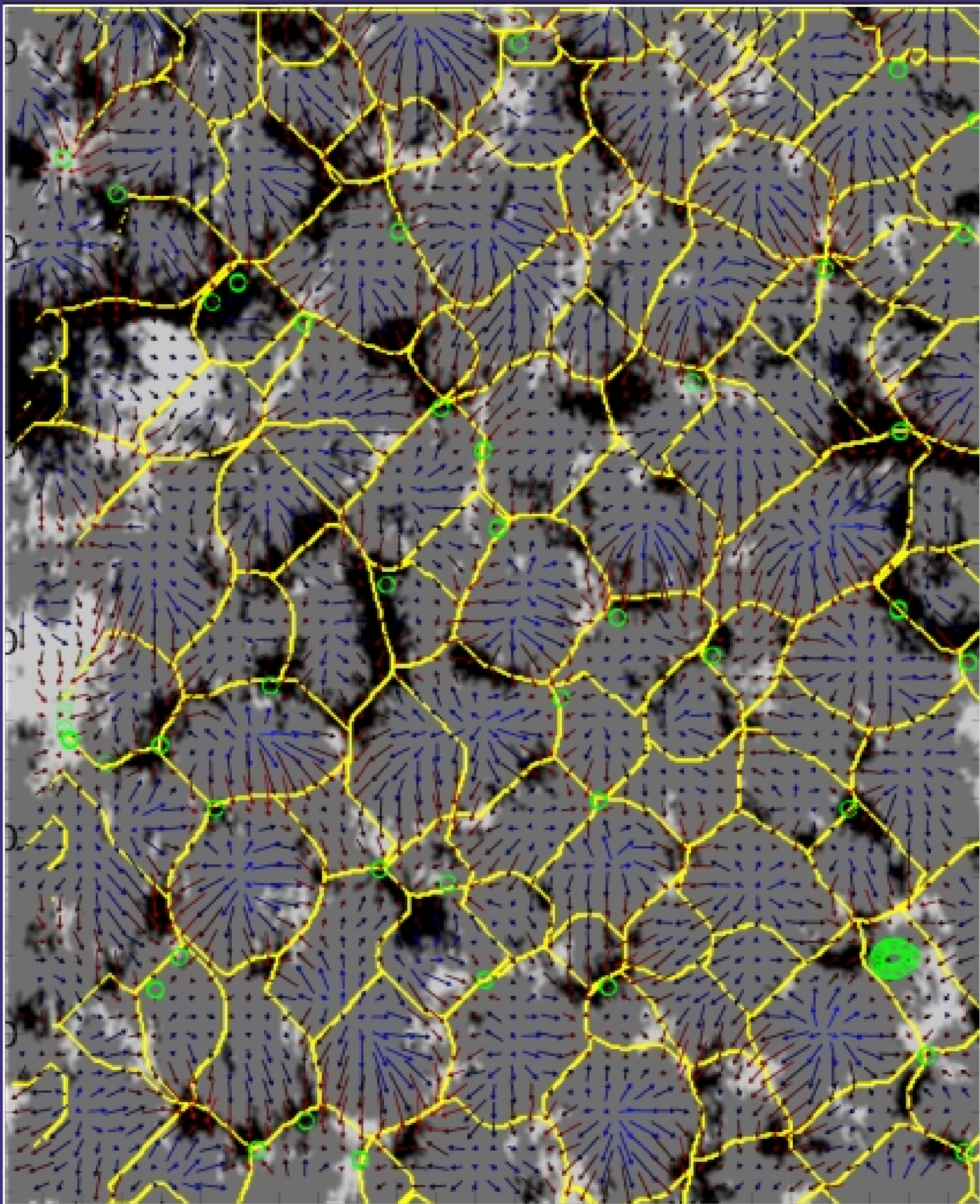
Line profile of O VI from UVCS observed in a polar coronal hole (lower panel) compared to disk observation from SUMER. The extremely broad O VI line yields velocities up to 500 km/s, which corresponds to a kinetic temperature of 200 million K.



UVCS/SOHO has discovered surprisingly fast spiraling motions for charged oxygen atoms (1.3 million Km/h) over the solar poles, as compared to hydrogen atoms (at about half this speed). The coiling speeds of oxygen atoms along the spirals are 20 times larger than were expected.

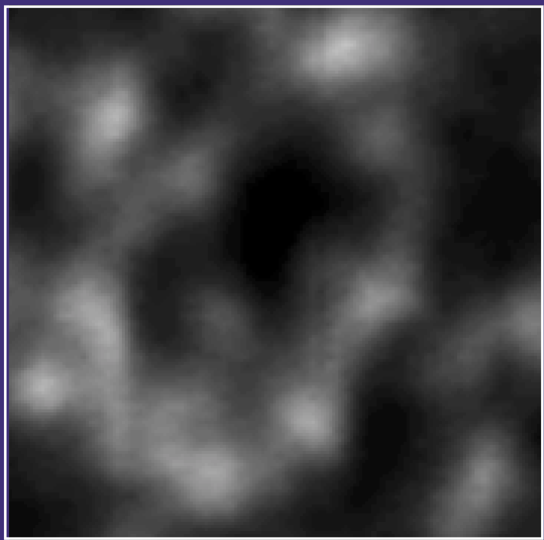


MDI Full Disk Magnetogram
9 May 1999

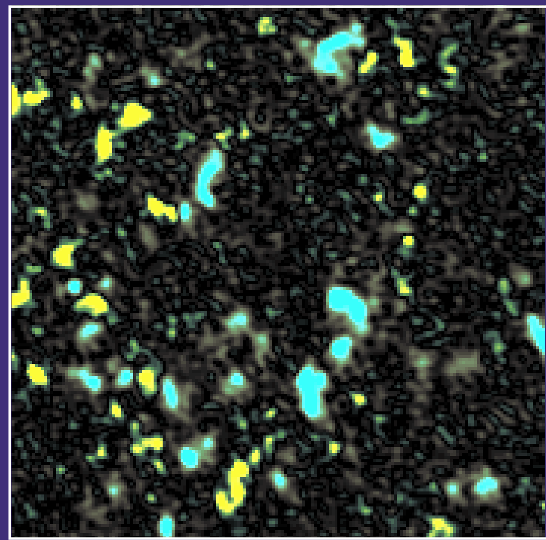


MDI magnetogram overlay with lines of convergence of the horizontal flow. Green dots show the convergence points. Measured flow is shown as colored arrows (red= downflow; blue= upflow).

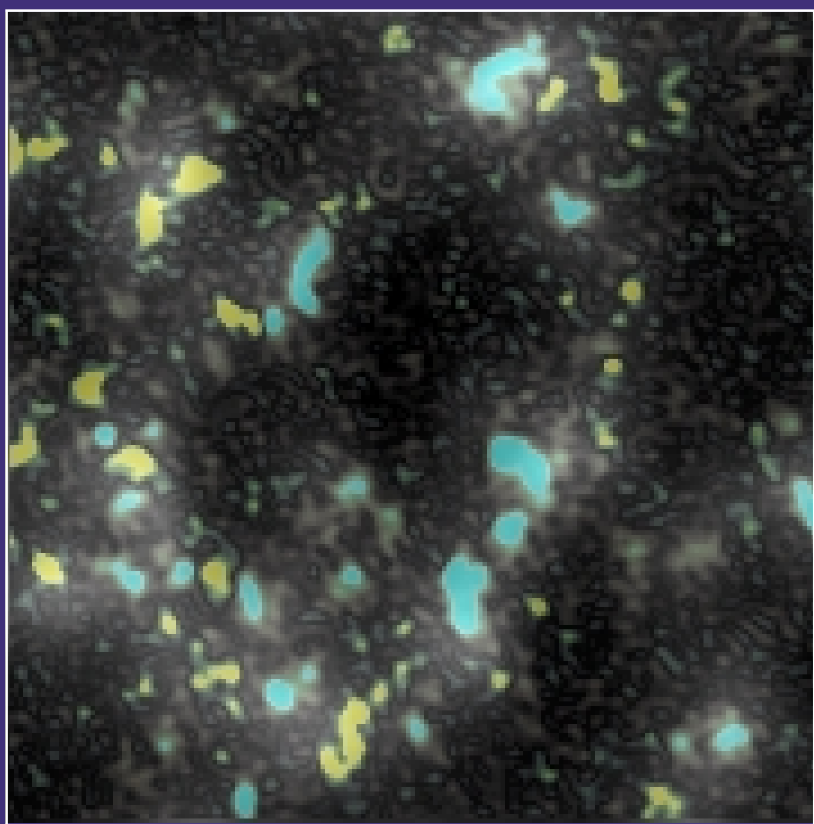
CDS OV intensity



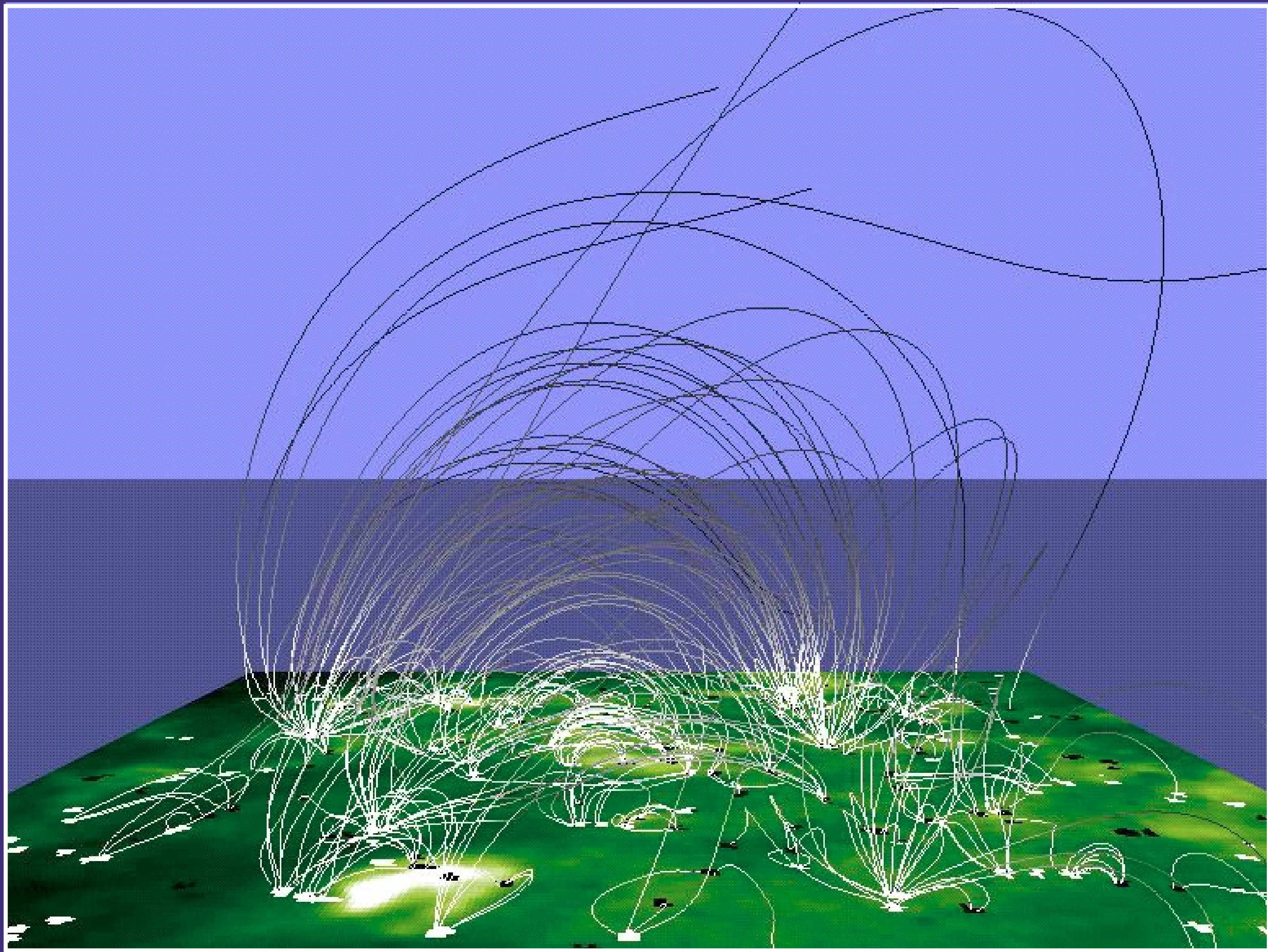
MDI magnetogram



Overlay of CDS and MDI

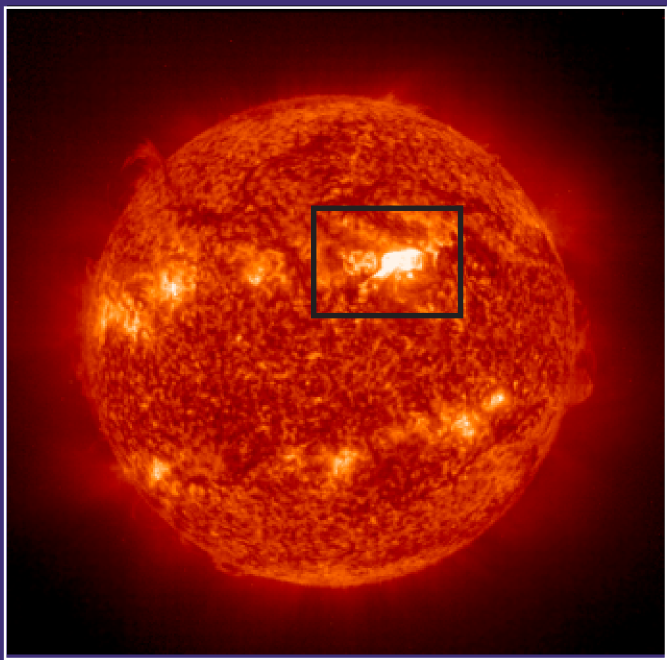


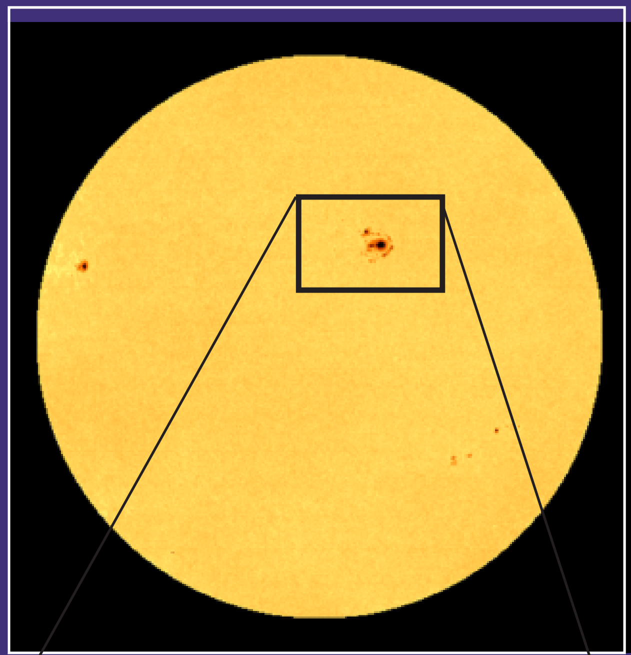
Correlation of transition region EUV emission and photospheric magnetic fields from observations by CDS and MDI

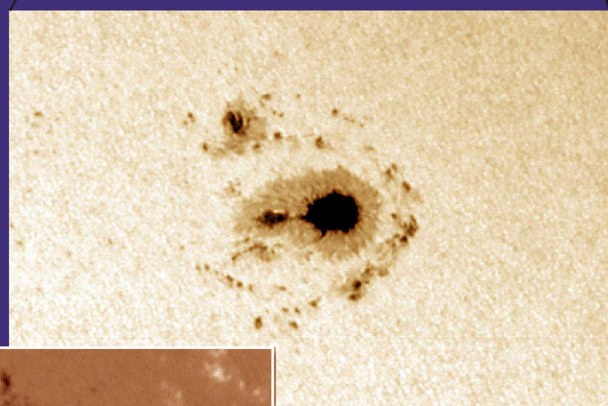


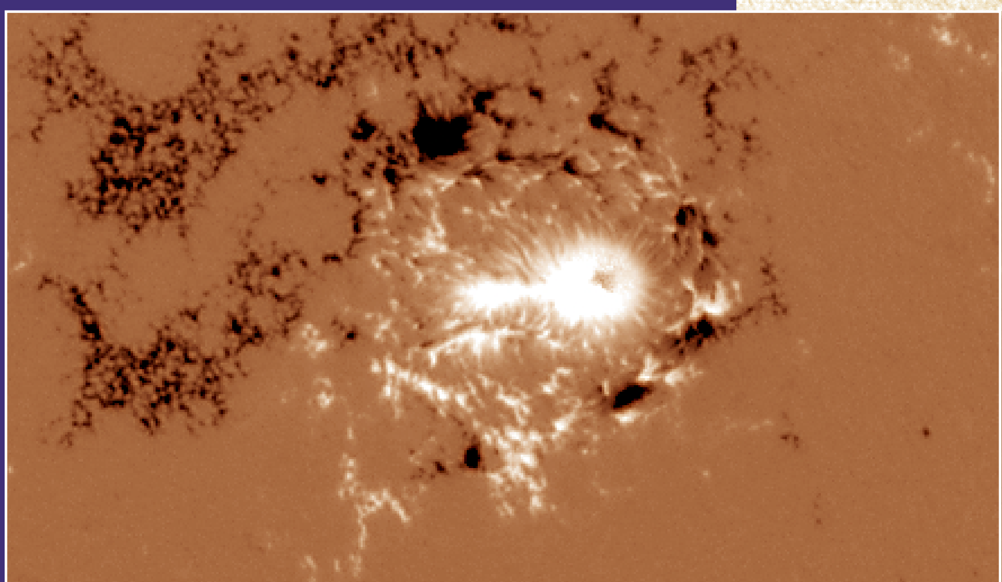
Model of magnetic field lines above the solar surface based on MDI magnetic field measurements superimposed on EIT coronal emission observations

5 November 1998









Close-up magnetogram image of sunspots

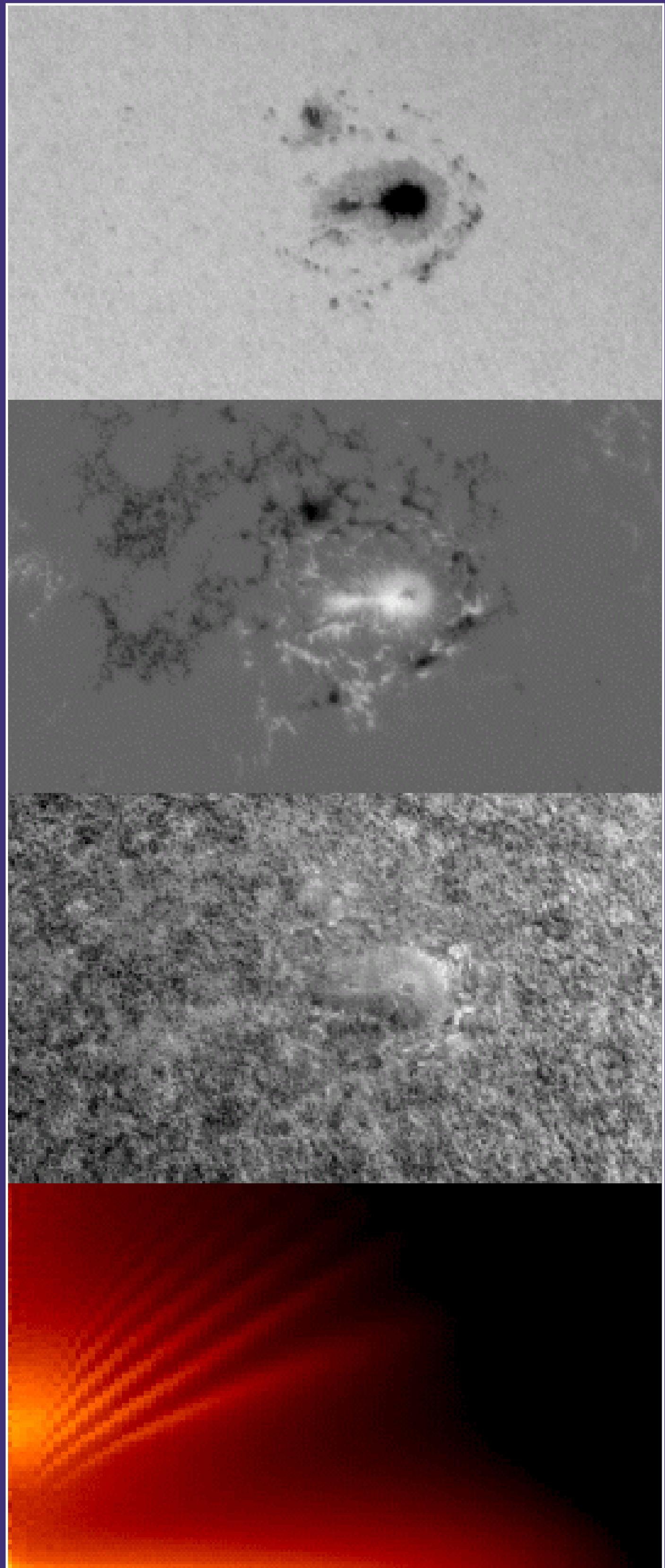
An EIT 304Å image, an MDI full disk white light image, with a close-up, and a high-resolution magnetogram all view the same magnetic structures that we call sunspots.

White light image

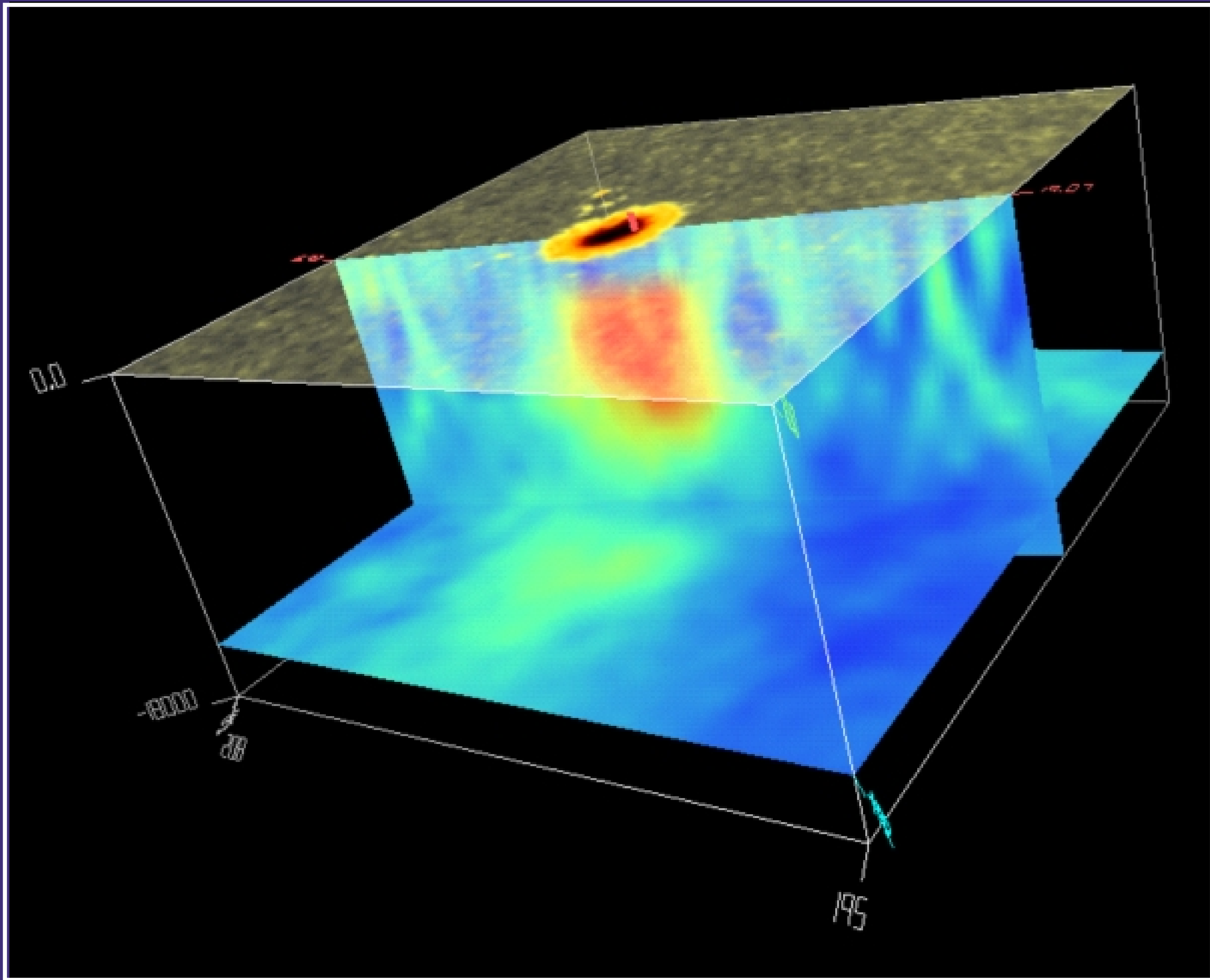
Magnetogram

Dopplergram

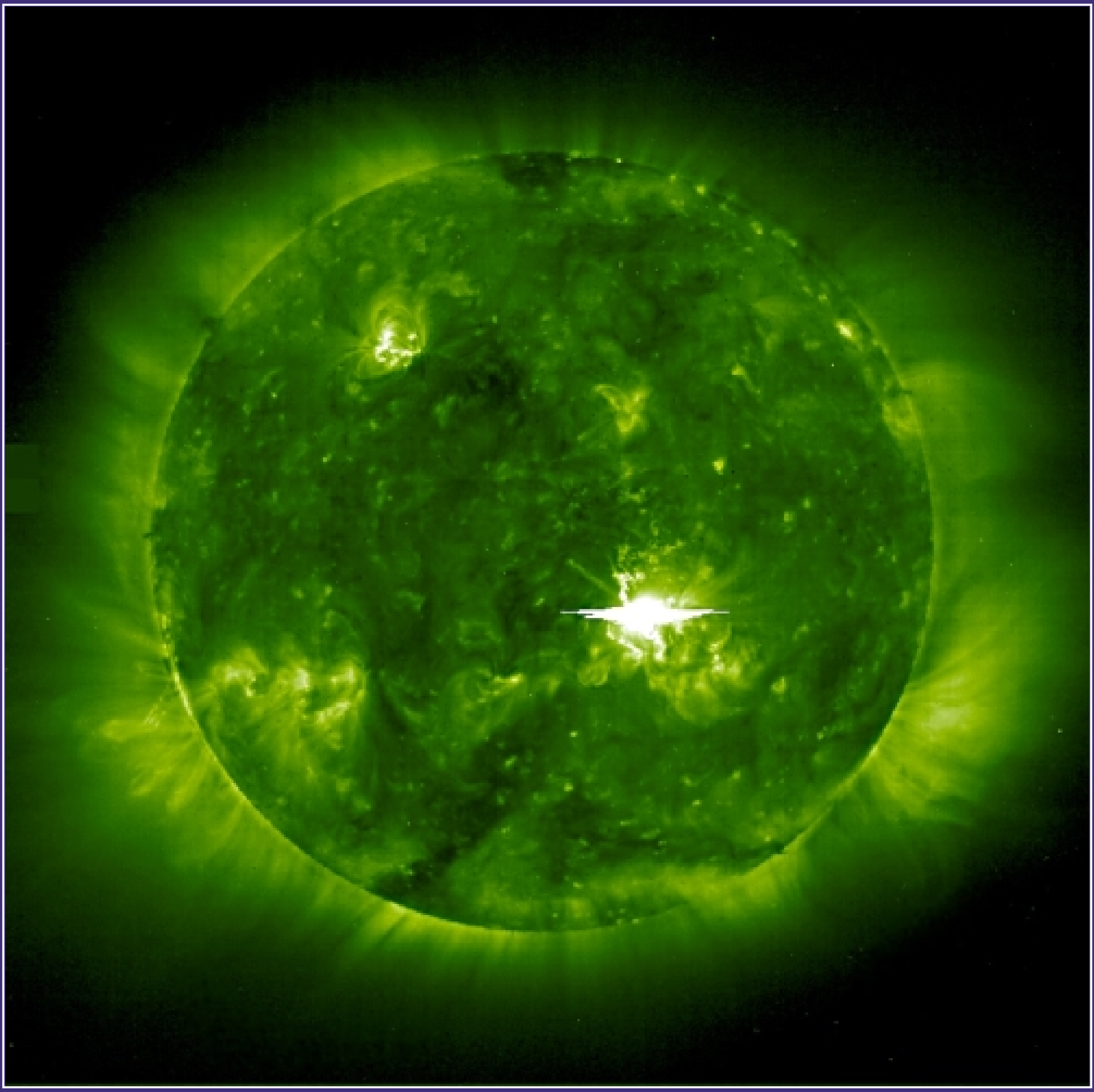
k-ω p mode spectrum



SOHO/MDI high resolution images of an active region, taken on 5 November 1998 after successfully recomissioning of the instrument

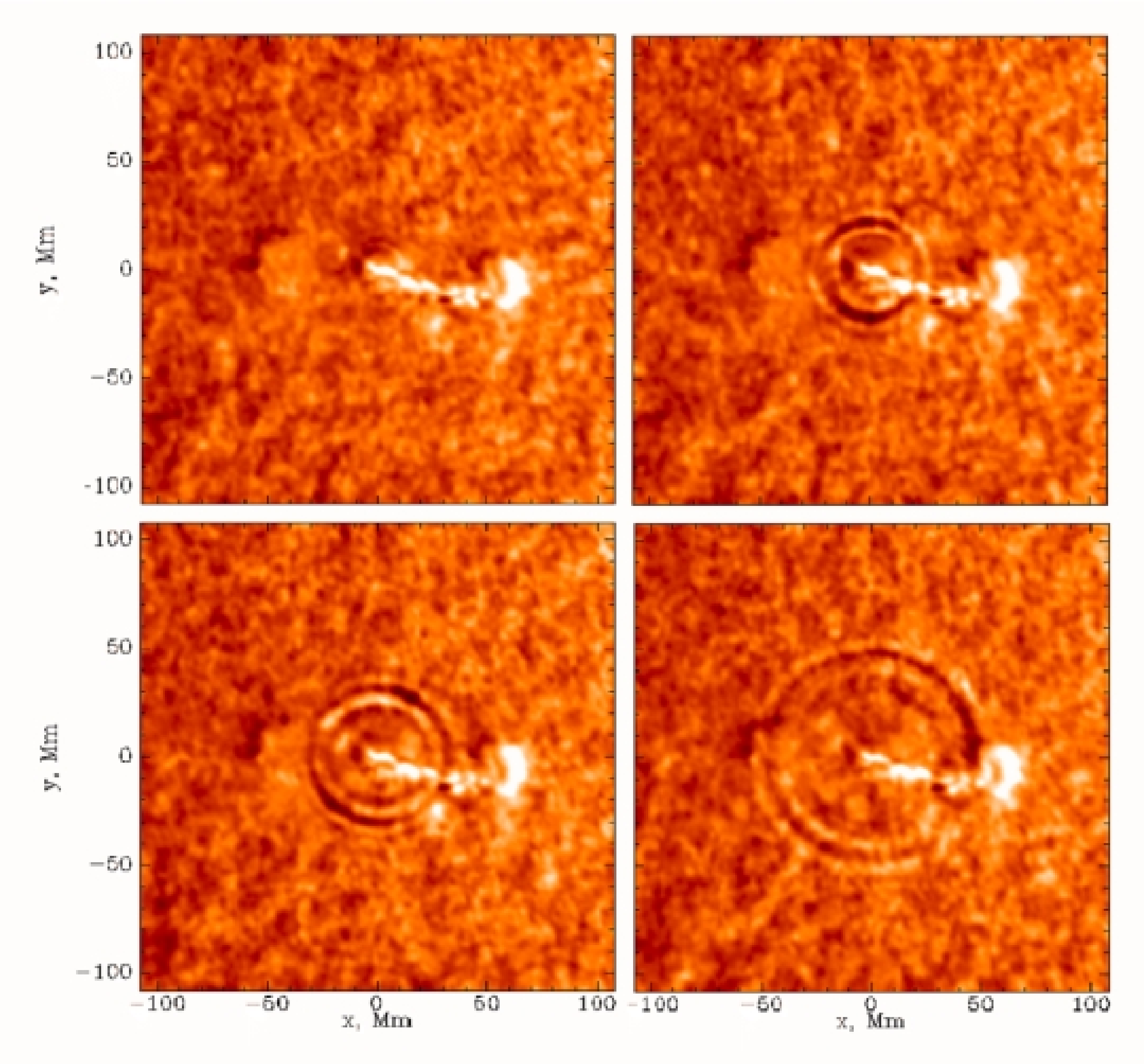


The subsurface structure (sound speed) below a sunspot as derived from Doppler measurements by MDI

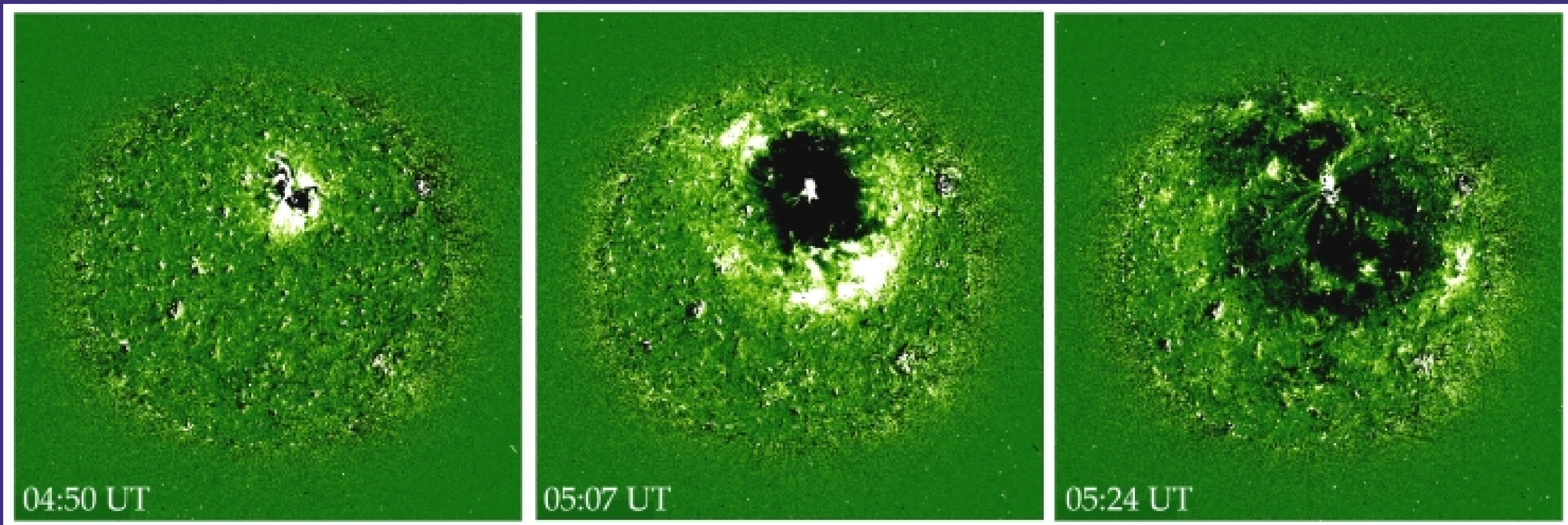


A bright solar flare captured on 2 May 1998 in the 195Å line of Fe XII

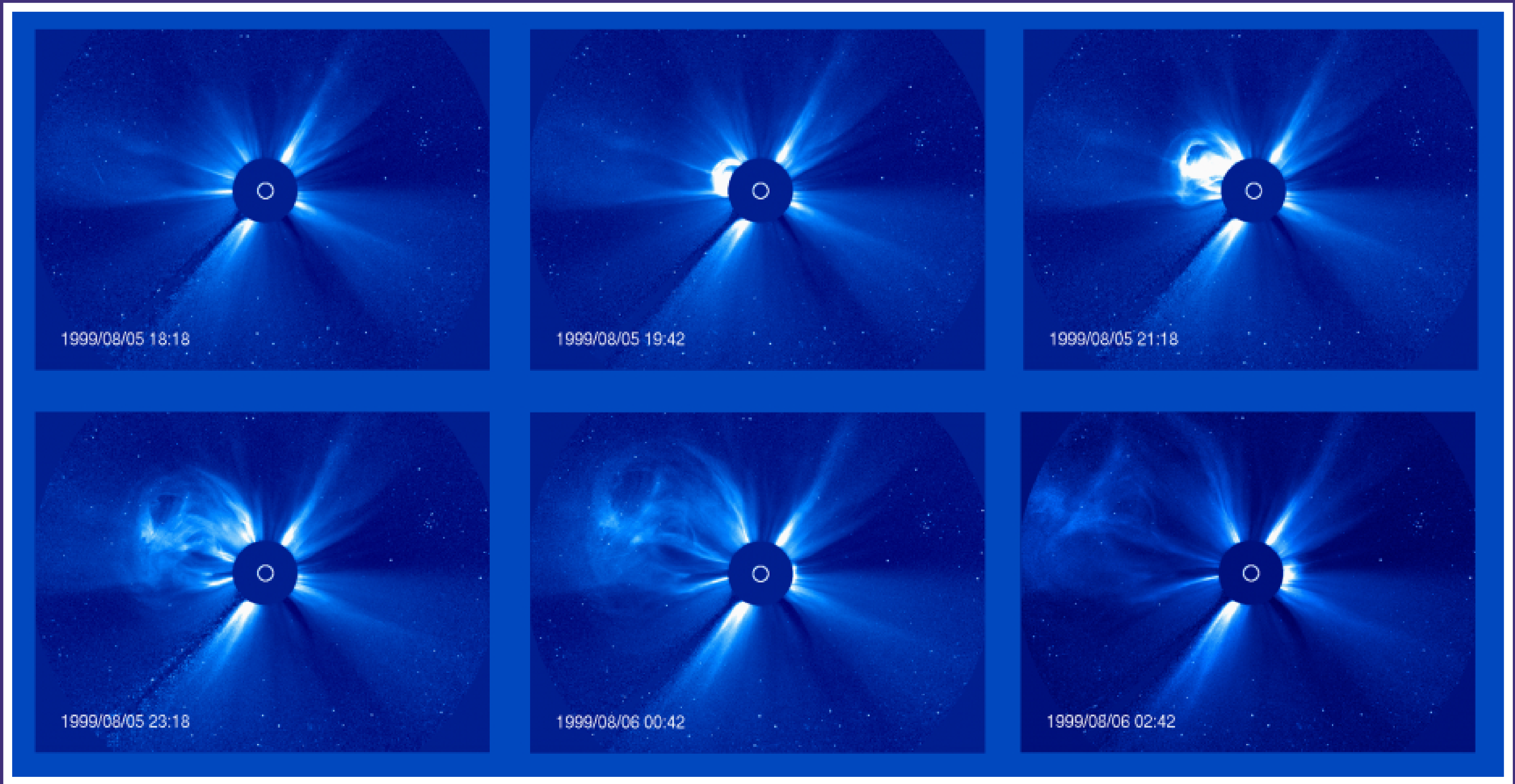
(The horizontal white line on either side of the flare was caused by charge bleeding on the CCD detector.)



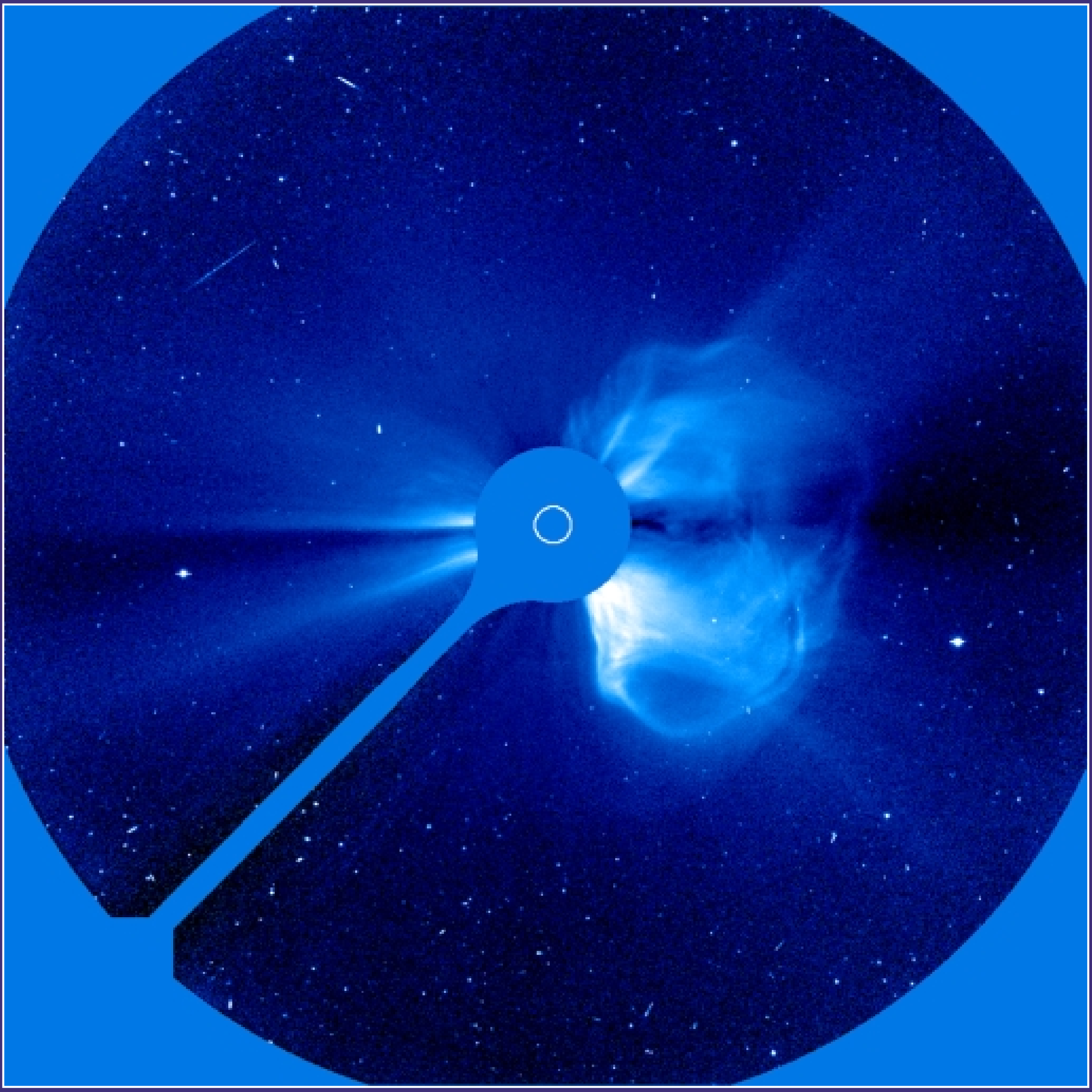
A rapidly expanding "solar quake" on the Sun's surface based on data from the Michelson Doppler Imager (MDI). The wave was caused by a solar flare on 6 July 1996 and spread out more than 100,000 km at the solar surface.



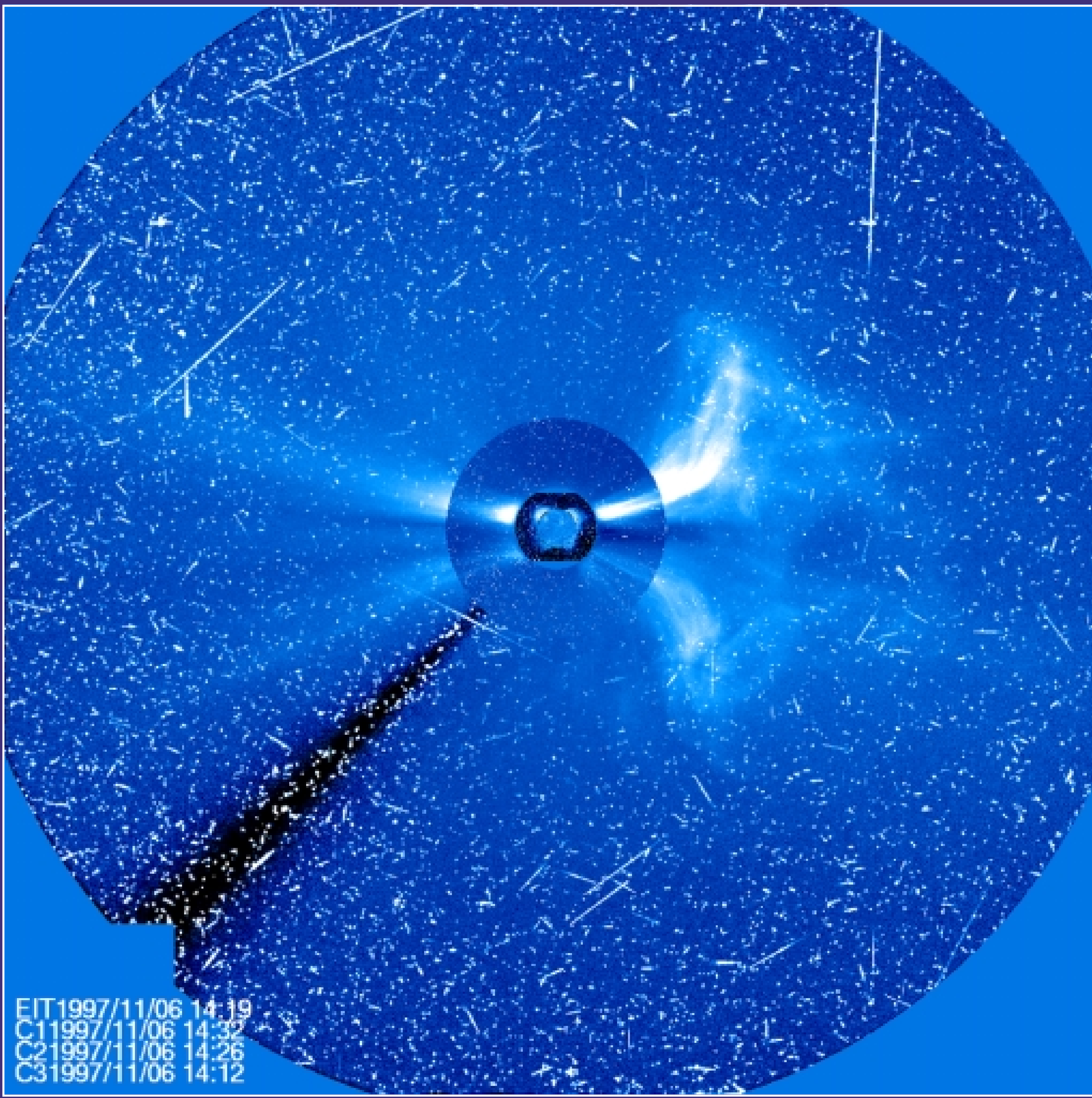
EIT observation of a shock wave expanding across much of the Sun's surface from a coronal mass ejection (CME) initiation site on 12 May 1997. This "running difference" imaging technique emphasizes the chages between successive frames.



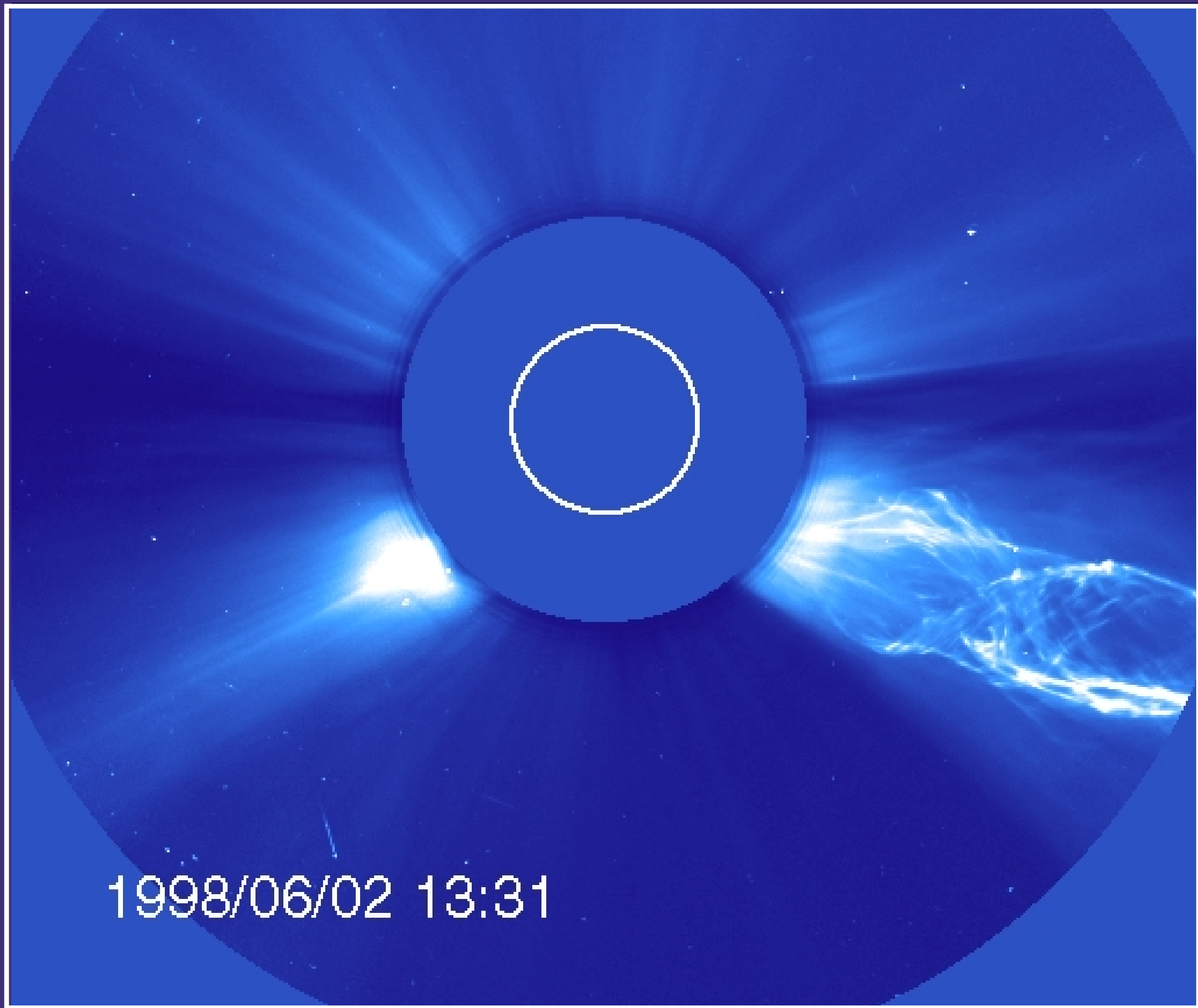
An image sequence showing the progress over eight hours of a clearly defined coronal mass ejection on 5-6 August 1999 taken by LASCO C3.



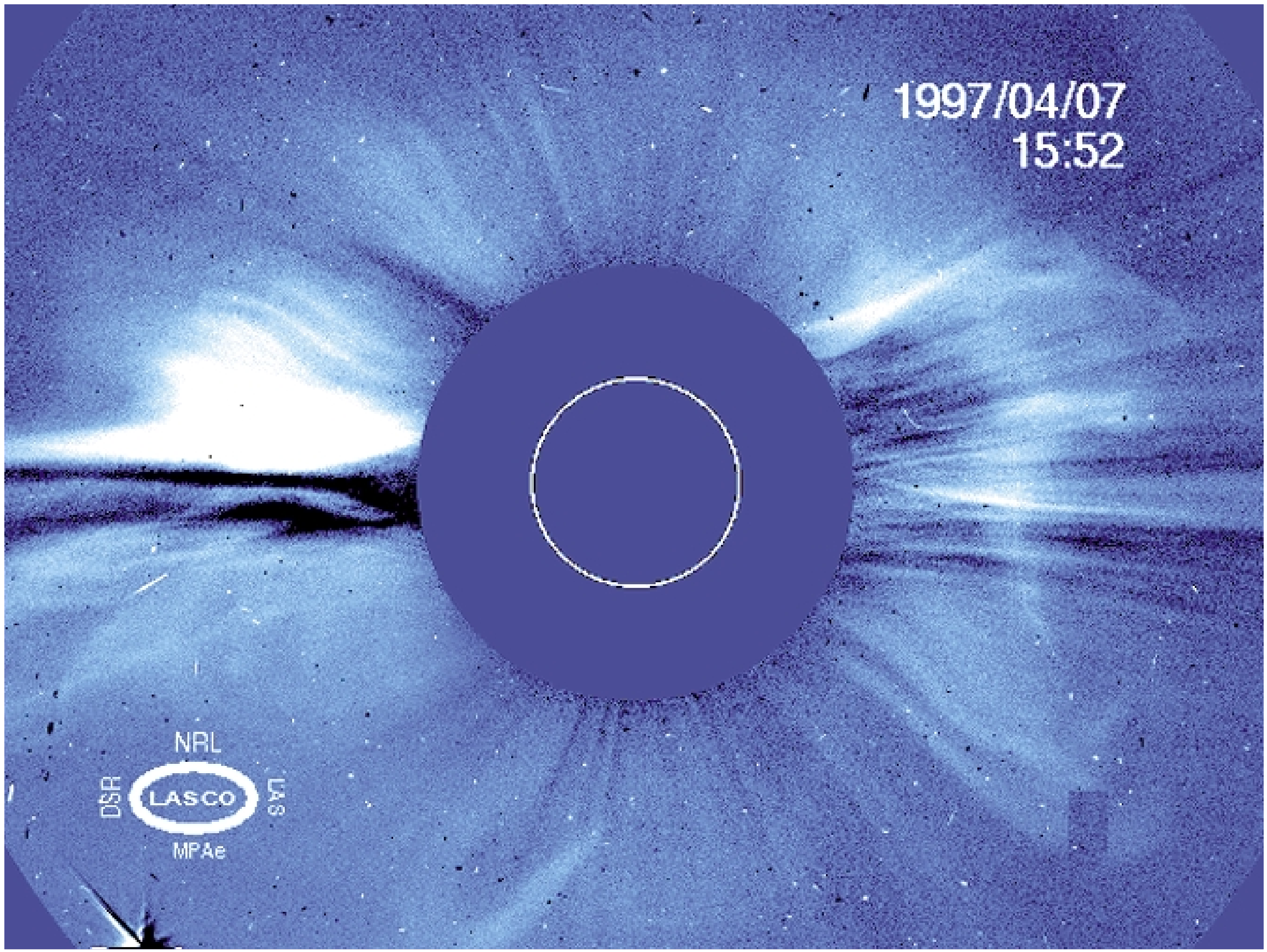
LASCO C3 image of the large coronal mass ejection (CME) of 20 April 1998



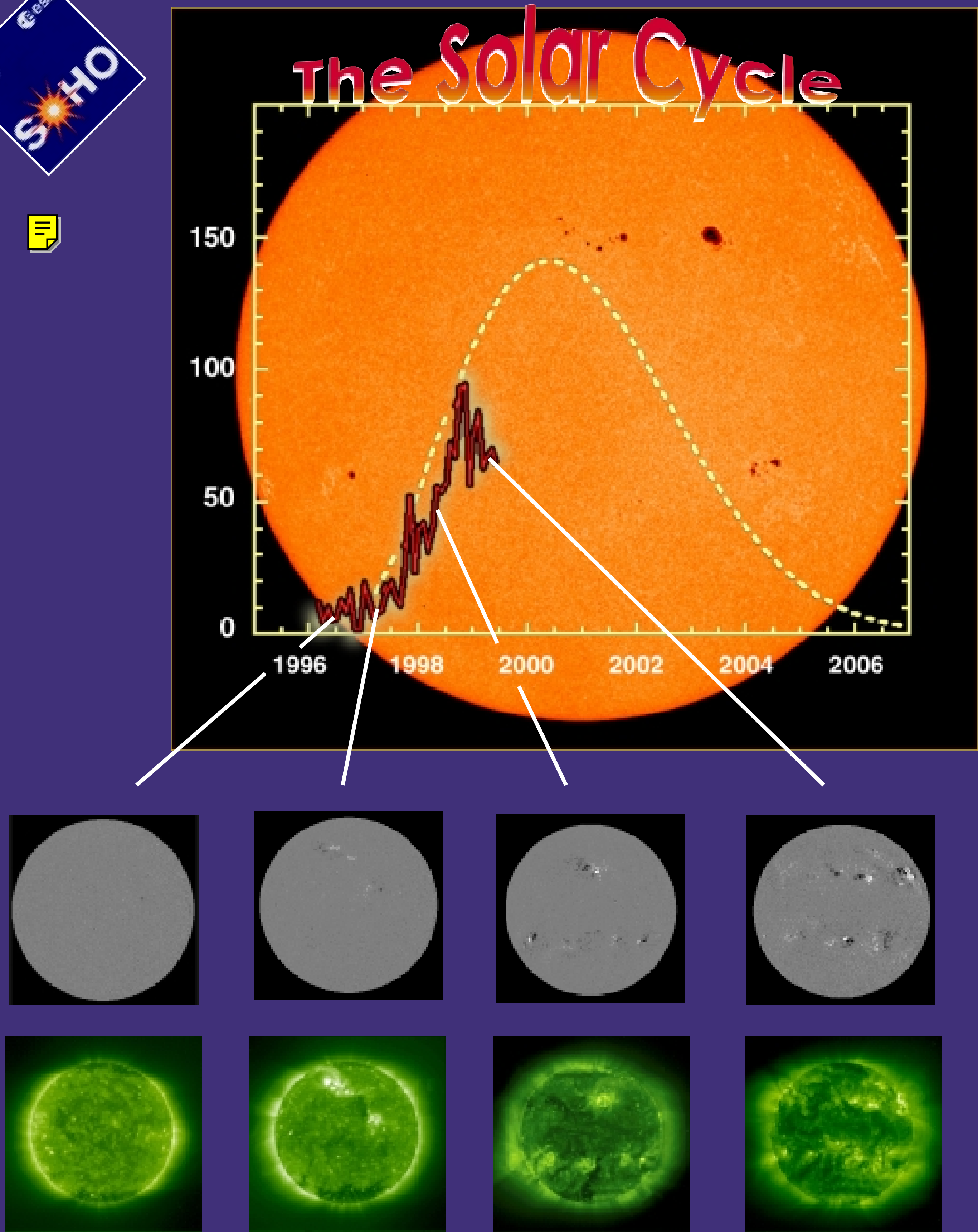
A composite of four images of a large CME from 6 November 1997, which was associated with an X-9.4 flare



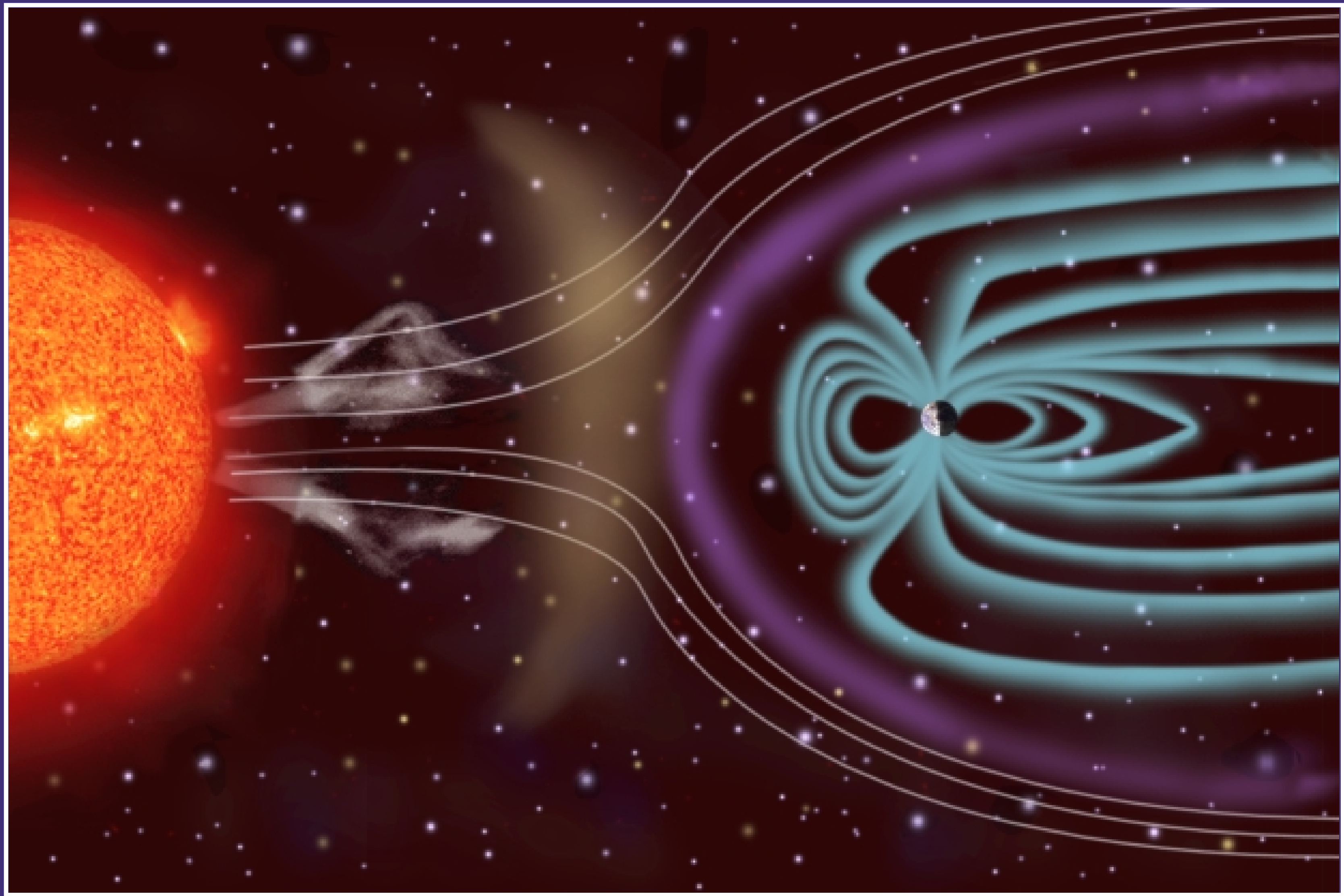
LASCO C2 coronograph image in which a twisting, helical-shaped CME spins off from the Sun



A LASCO C2 “running difference” image showing a “halo” CME blast beginning its journey towards Earth

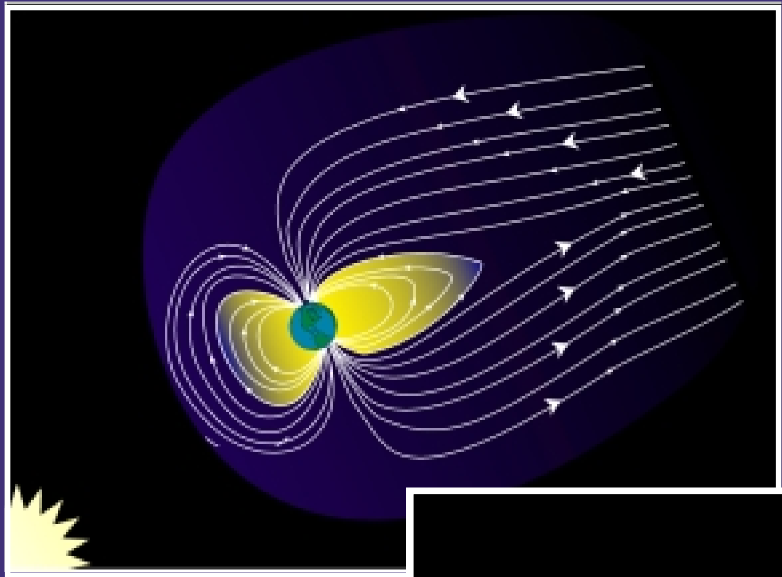


The rise of activity cycle 23 as reflected by the number of sunspots recorded to date and as projected (dotted line). Selected EIT 195Å images and MDI magnetograms are shown.

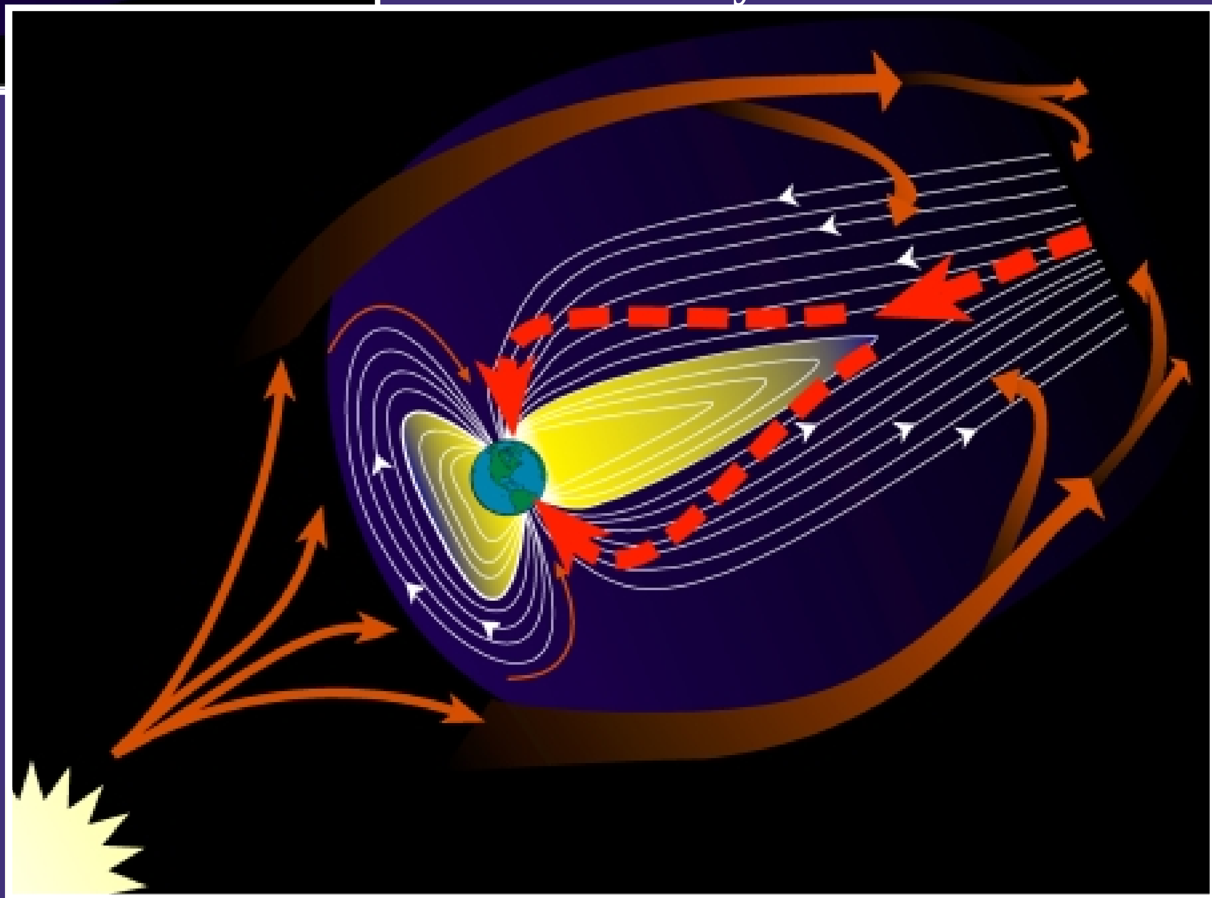


The Sun's magnetic field and plasma releases directly affect Earth and the rest of the solar system. This schematic view illustrates a magnetic storm approaching Earth and how the solar wind shapes the Earth's magnetosphere.

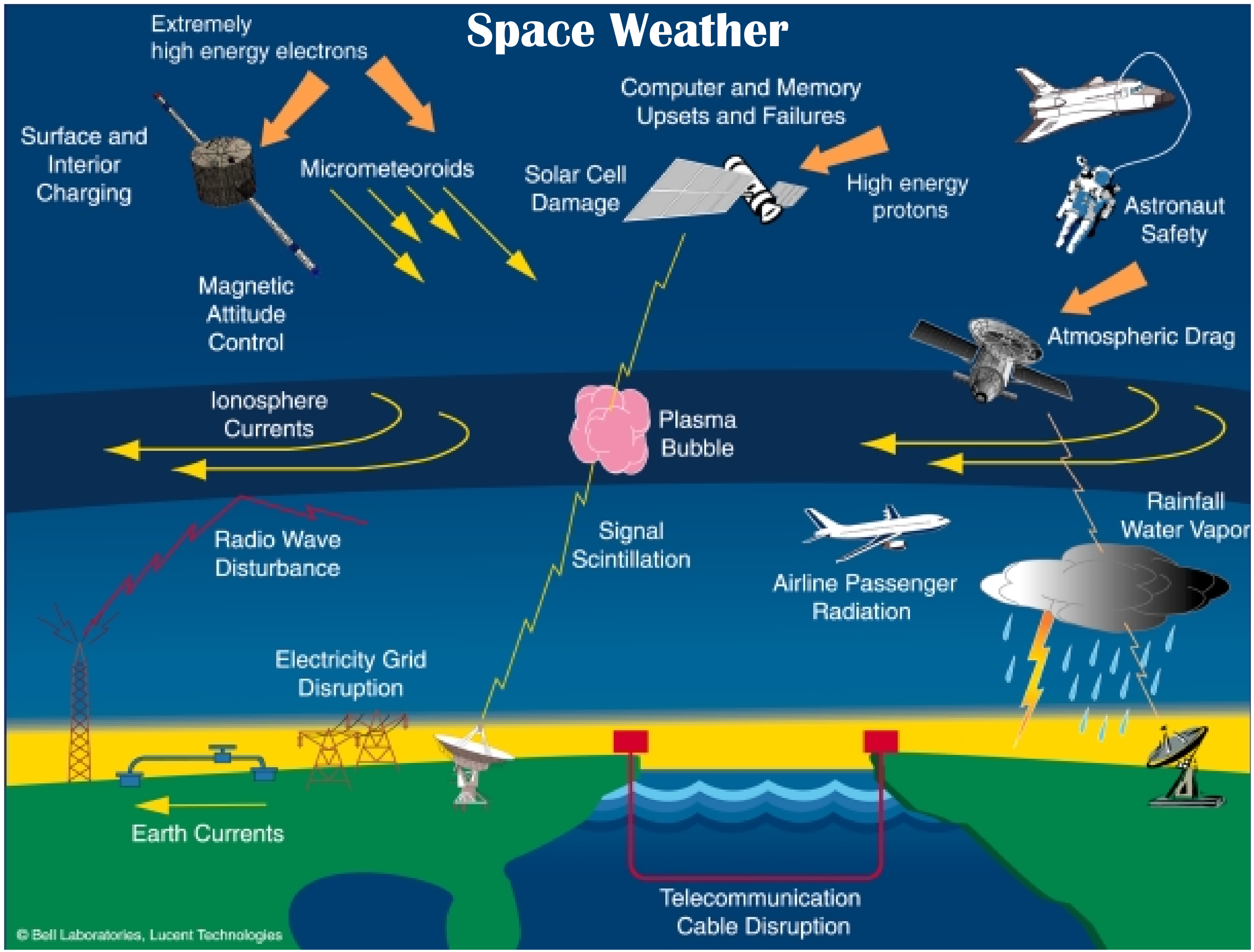
Normal magnetosphere



Magnetosphere being affected by a CME



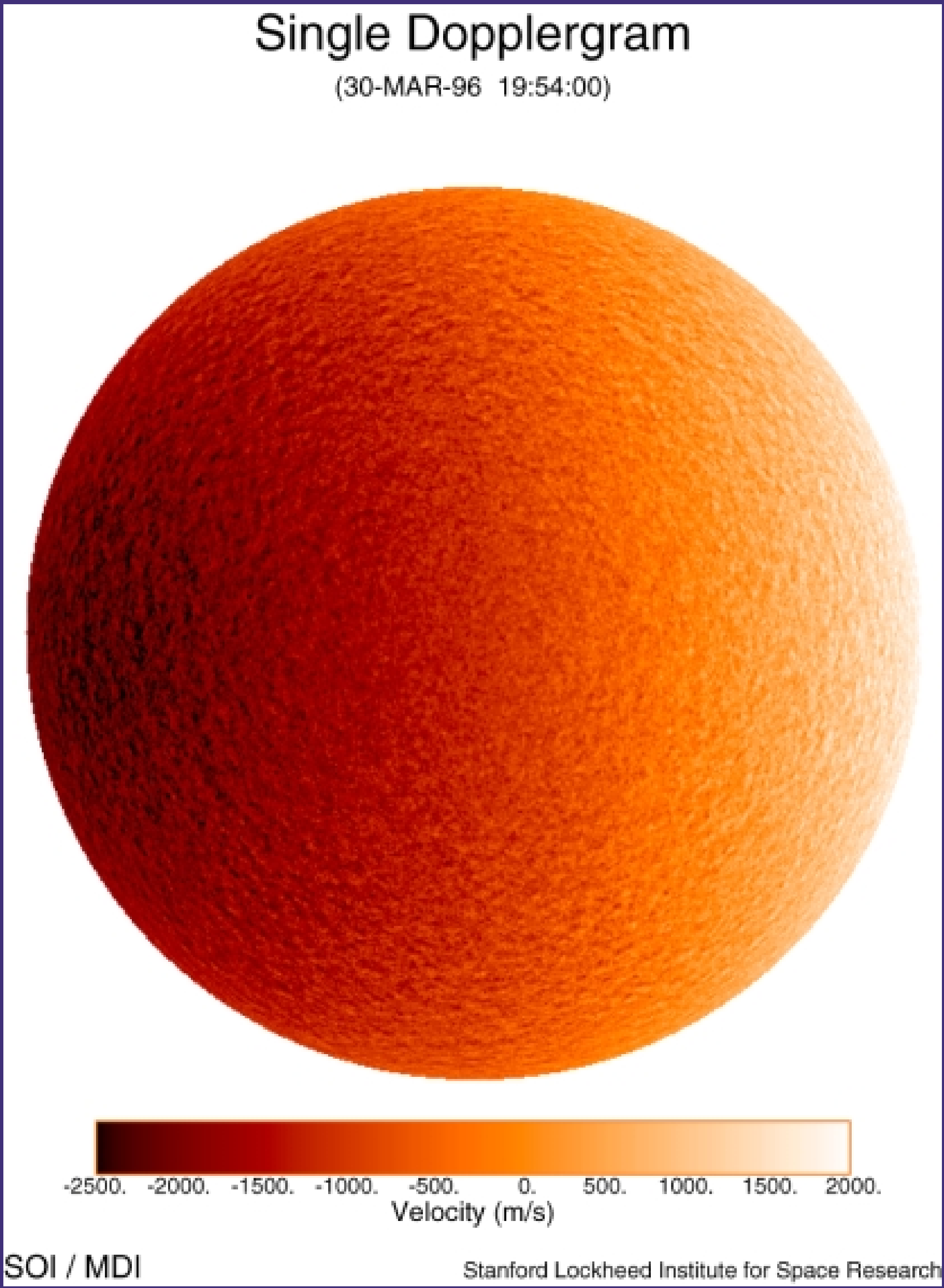
When the particles from a CME impact the Earth's magnetosphere , the sunward side flattens and the tail elongates. Note that most particles are drawn in on the far side.



The numerous effects of space weather

Credit: Jan Curtis

An aurora, the most spectacular visual effect of magnetic storms seen on Earth



MDI Full Disk Dopplergram

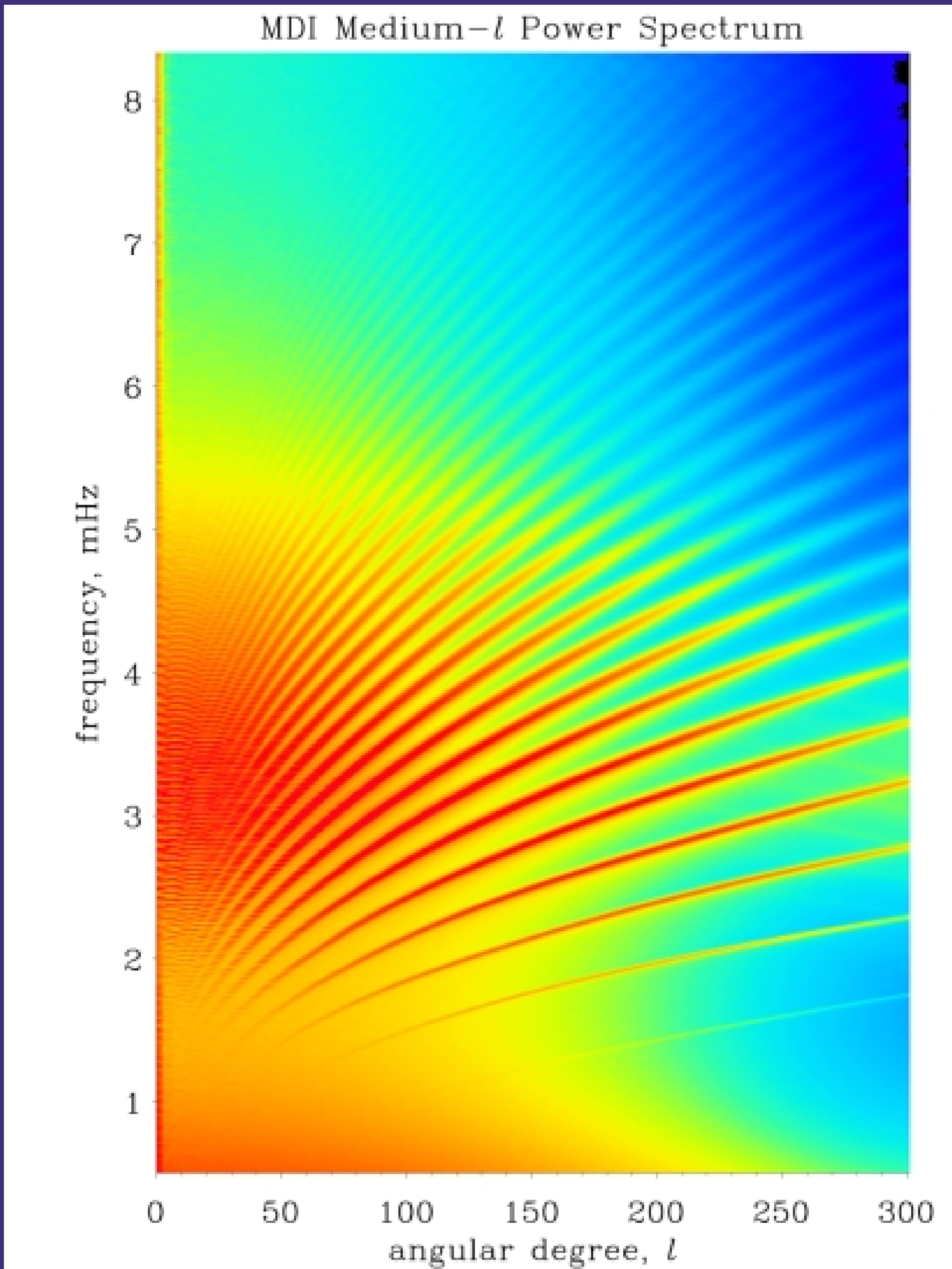
(dark colors = motion toward the observer)

MDI Full Disk Dopplergram

showing superanular convection cells on the Sun's surface

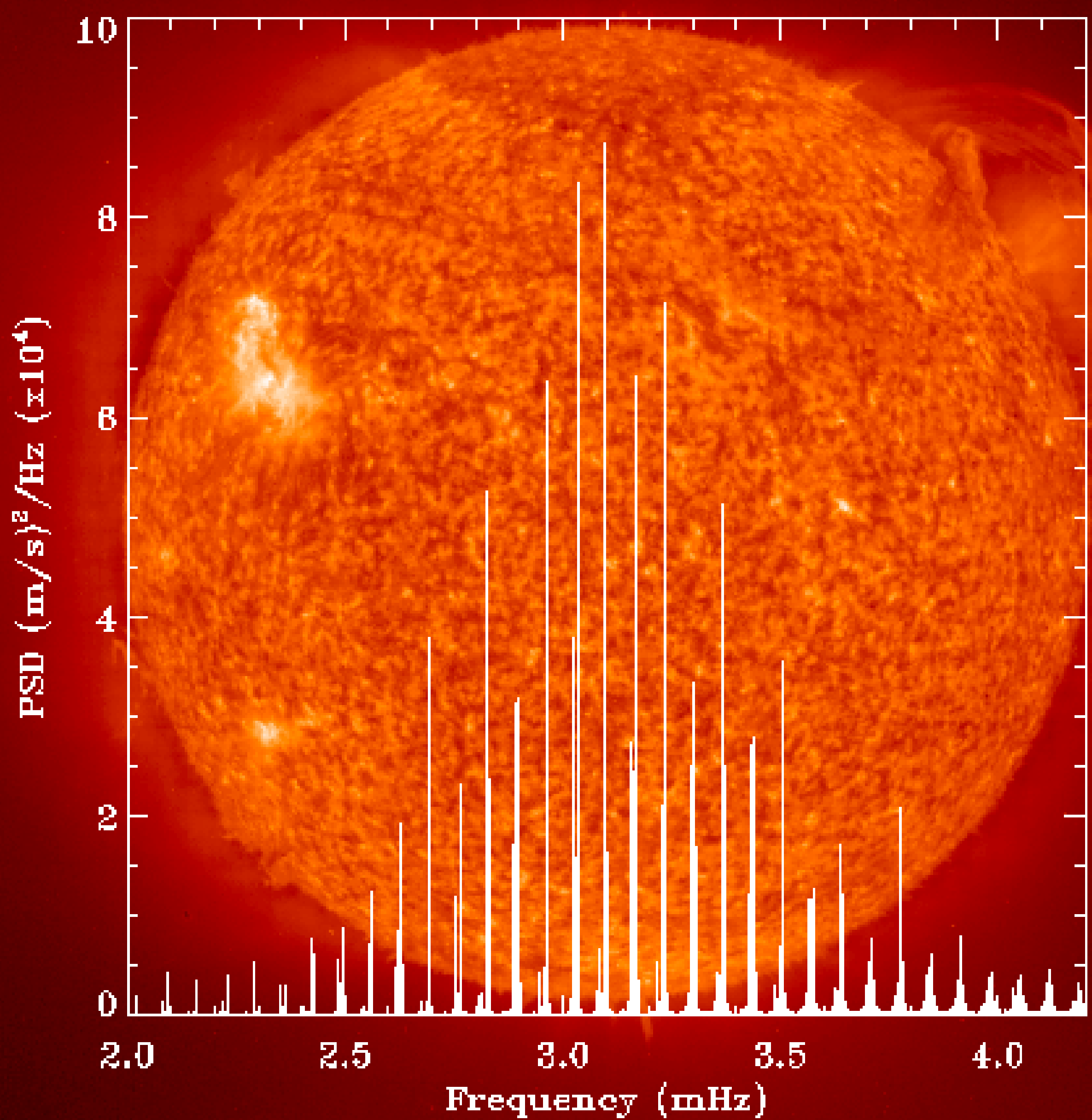
MDI Full Disk Dopplergram

showing the p-mode oscillations of the Sun

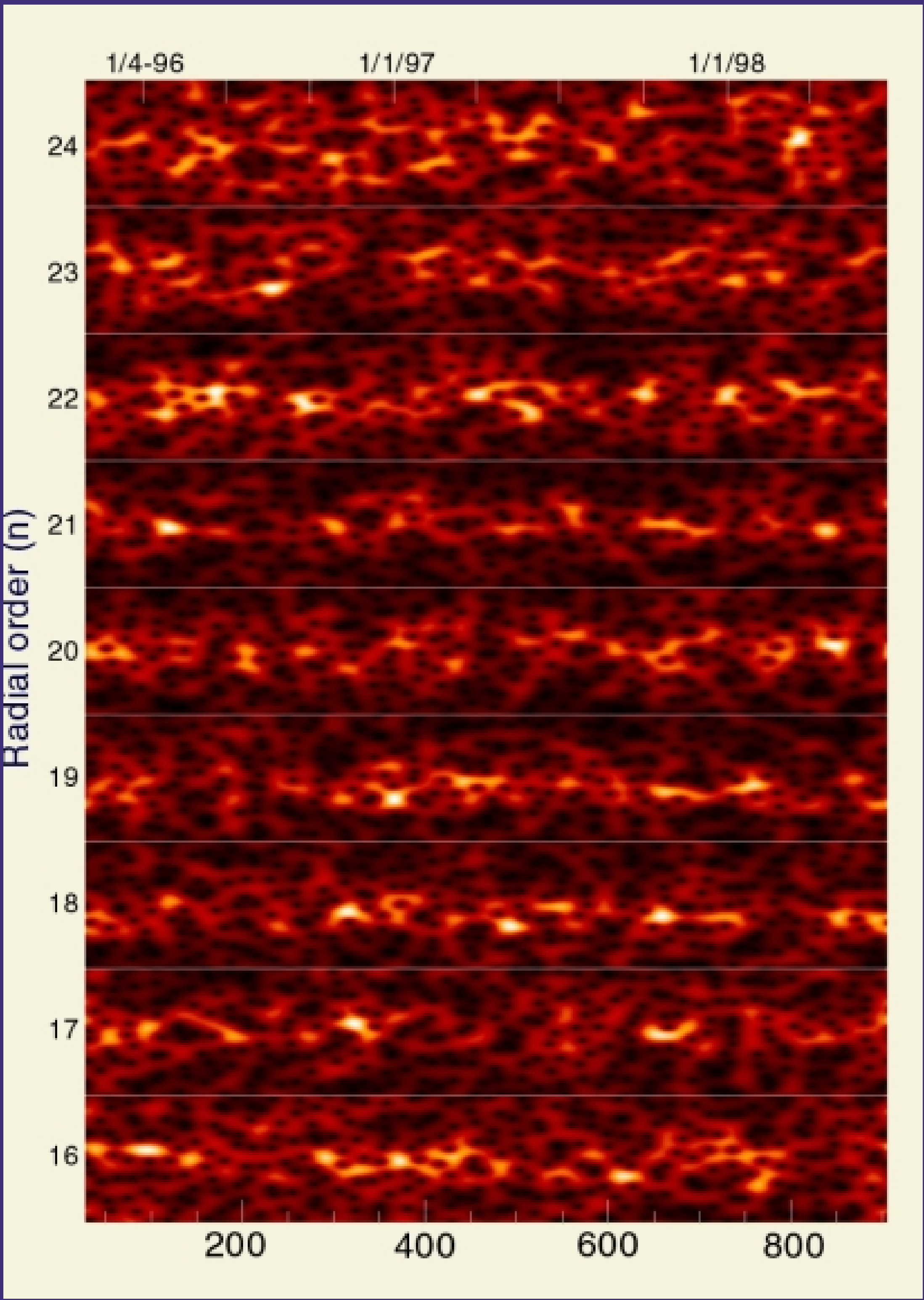


Power spectrum obtained from 2 months of continuous MDI data (May/June 1996). The "ridges" of greater power result from standing sound waves resonating within the Sun.

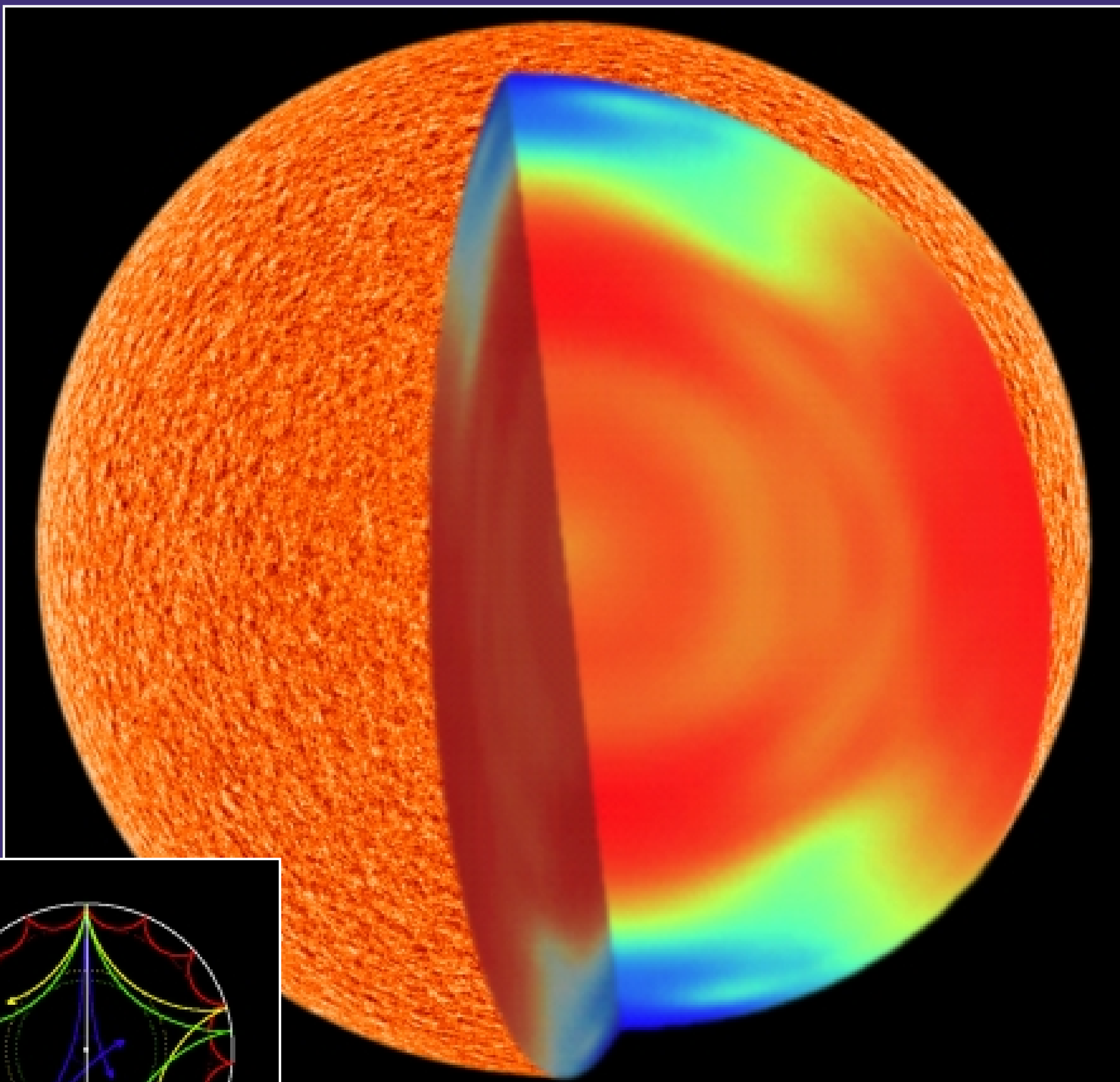
Structure of the Solar Interior

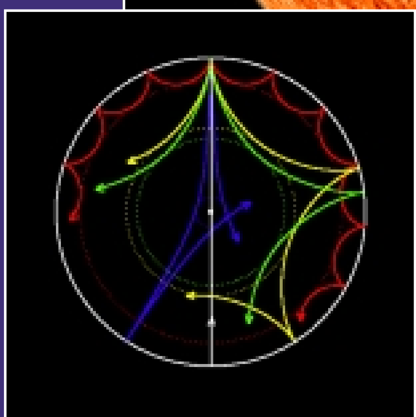


Fourier spectrum of global oscillations observed by GOLF

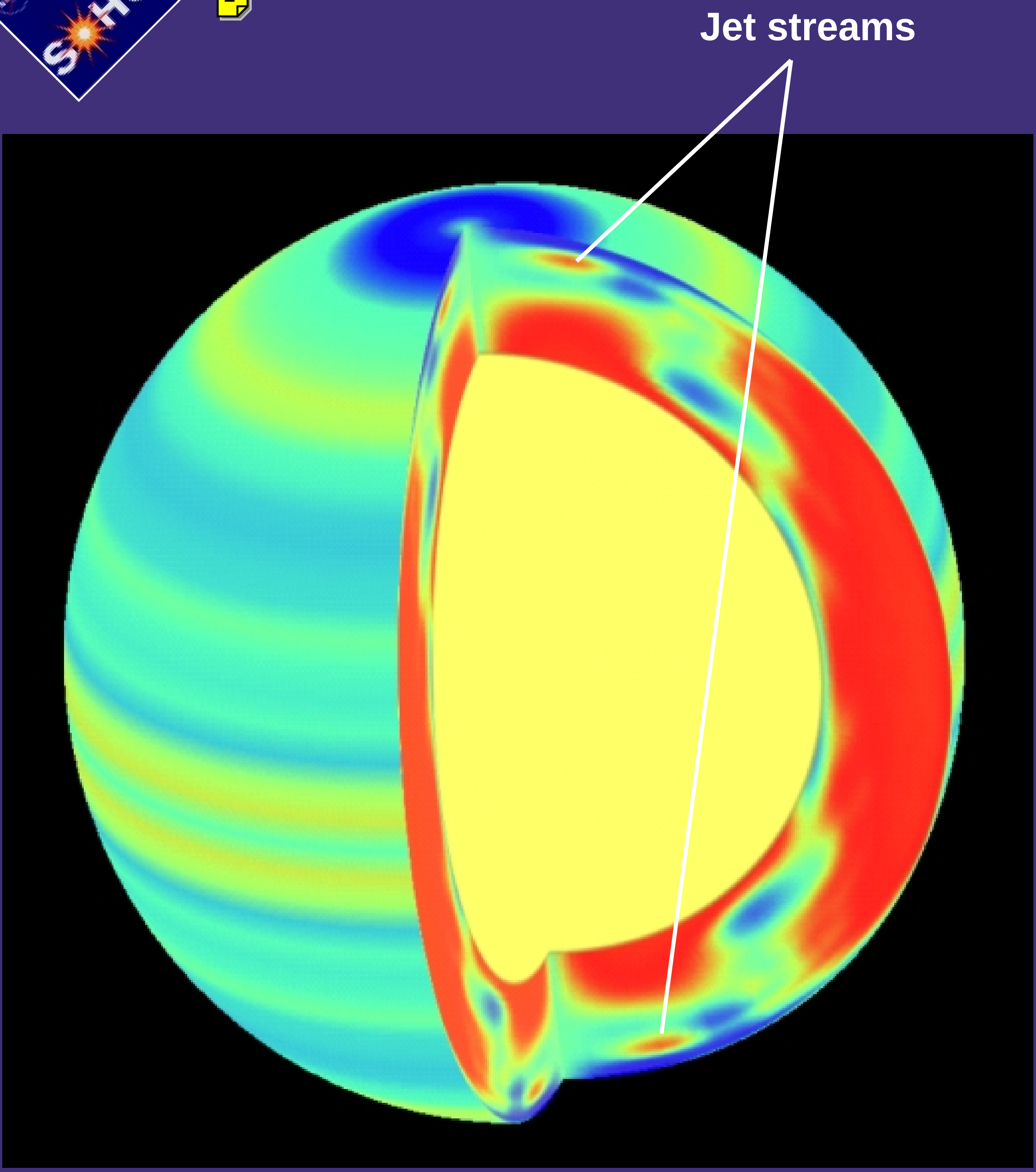


Temporal variations of the amplitudes of solar p-modes as measured by VIRGO

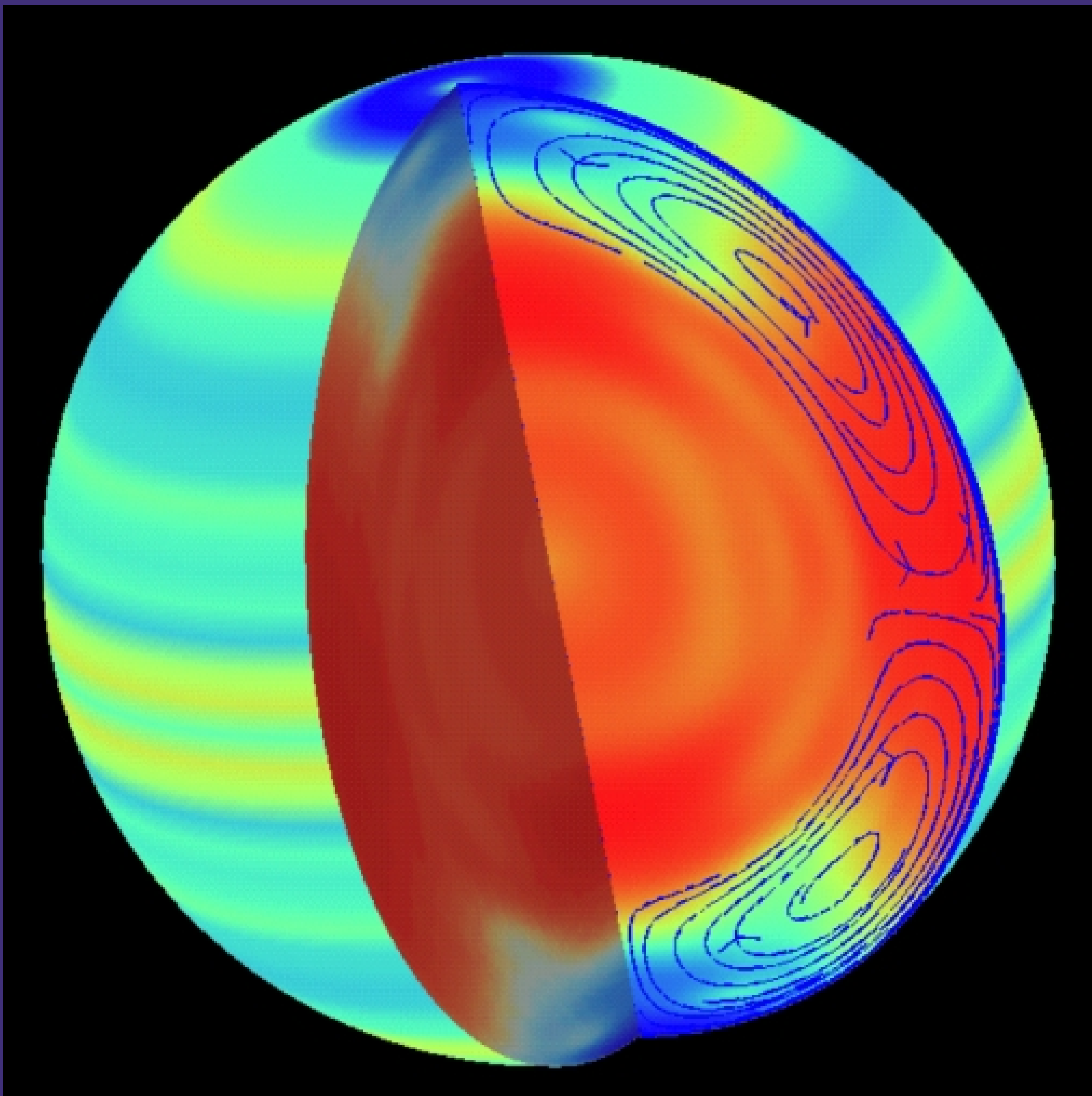




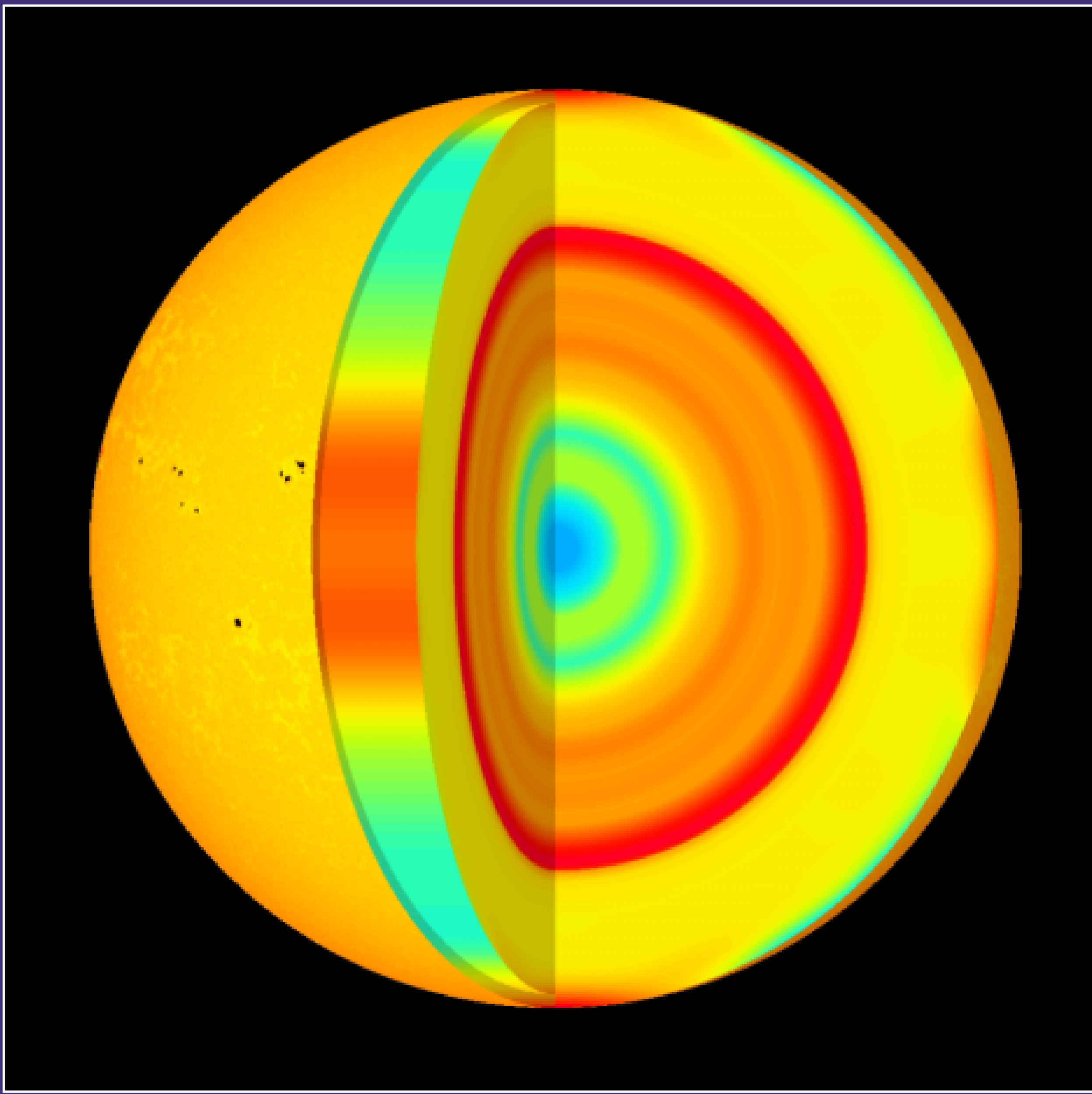
An MDI dopplergram image of the Sun's surface is merged with a helioseismology image of the flows of plasma in the solar interior. The smaller diagram shows the paths of several different acoustic (pressure) waves inside of the Sun whose measurements reveal its internal structure.



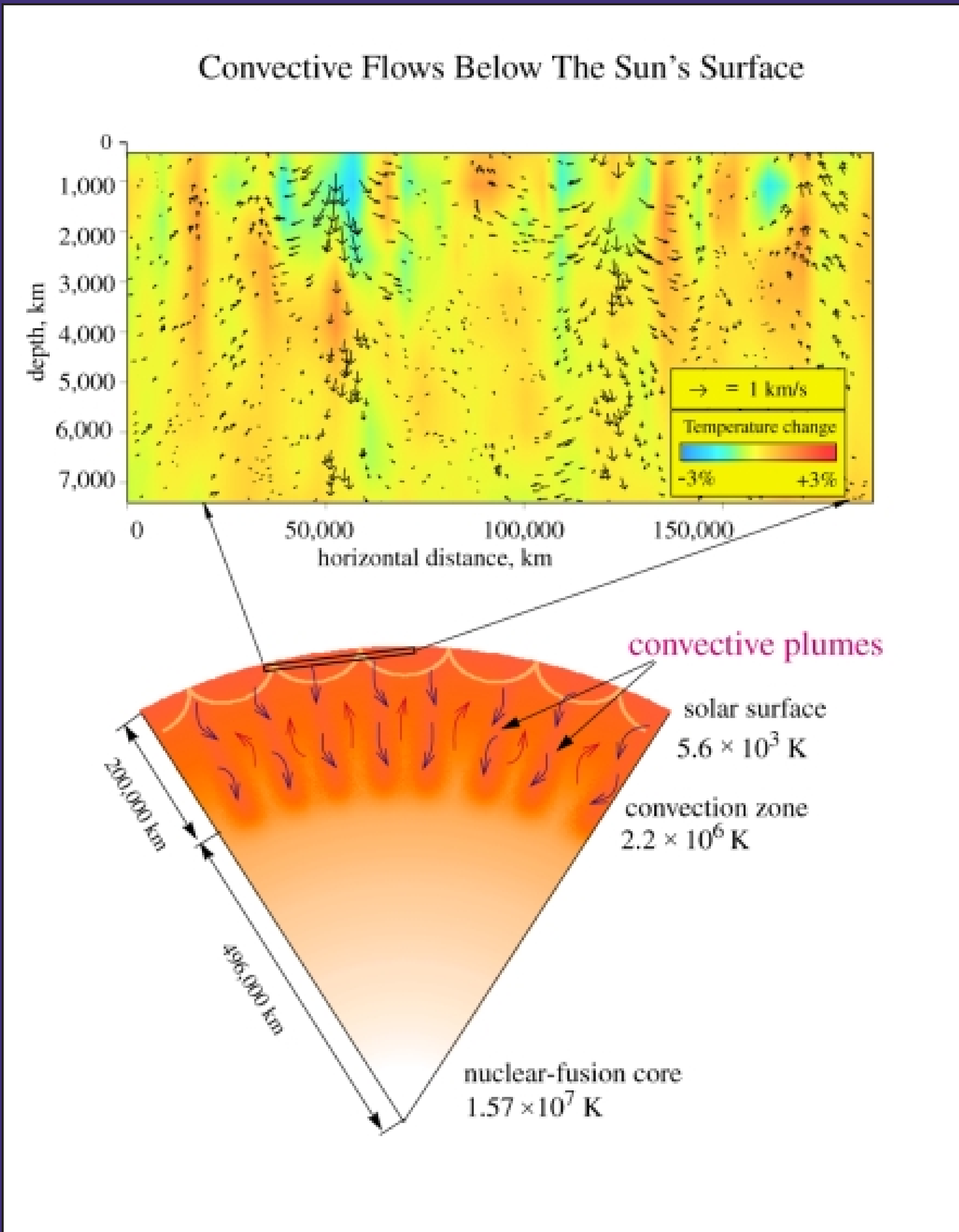
Polar plasma jet streams and variation in rotational speed in the solar interior as measured by MDI



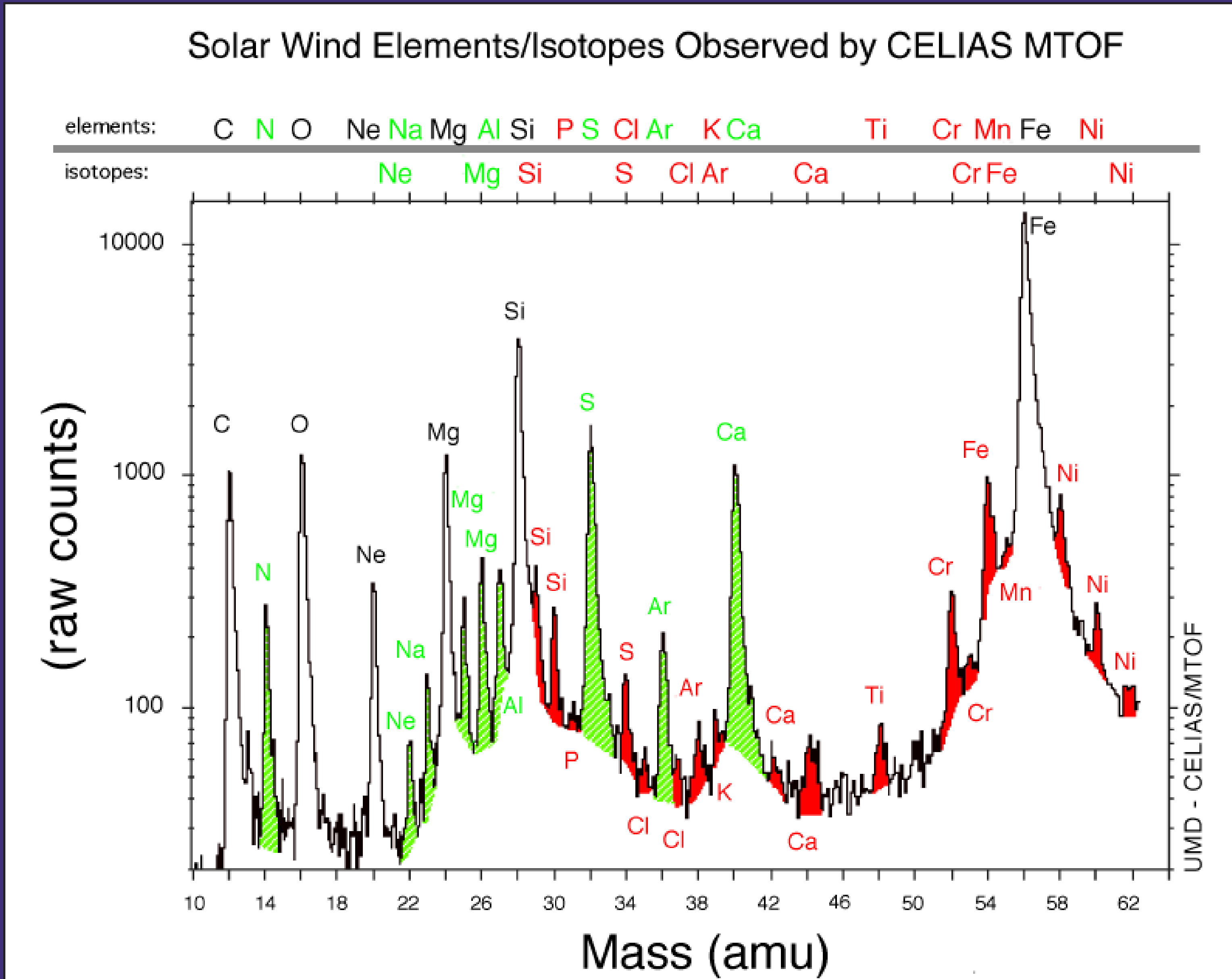
Solar rotation and polar flows of the Sun as deduced from measurements by MDI. The cutaway reveals rotation speed inside the Sun.



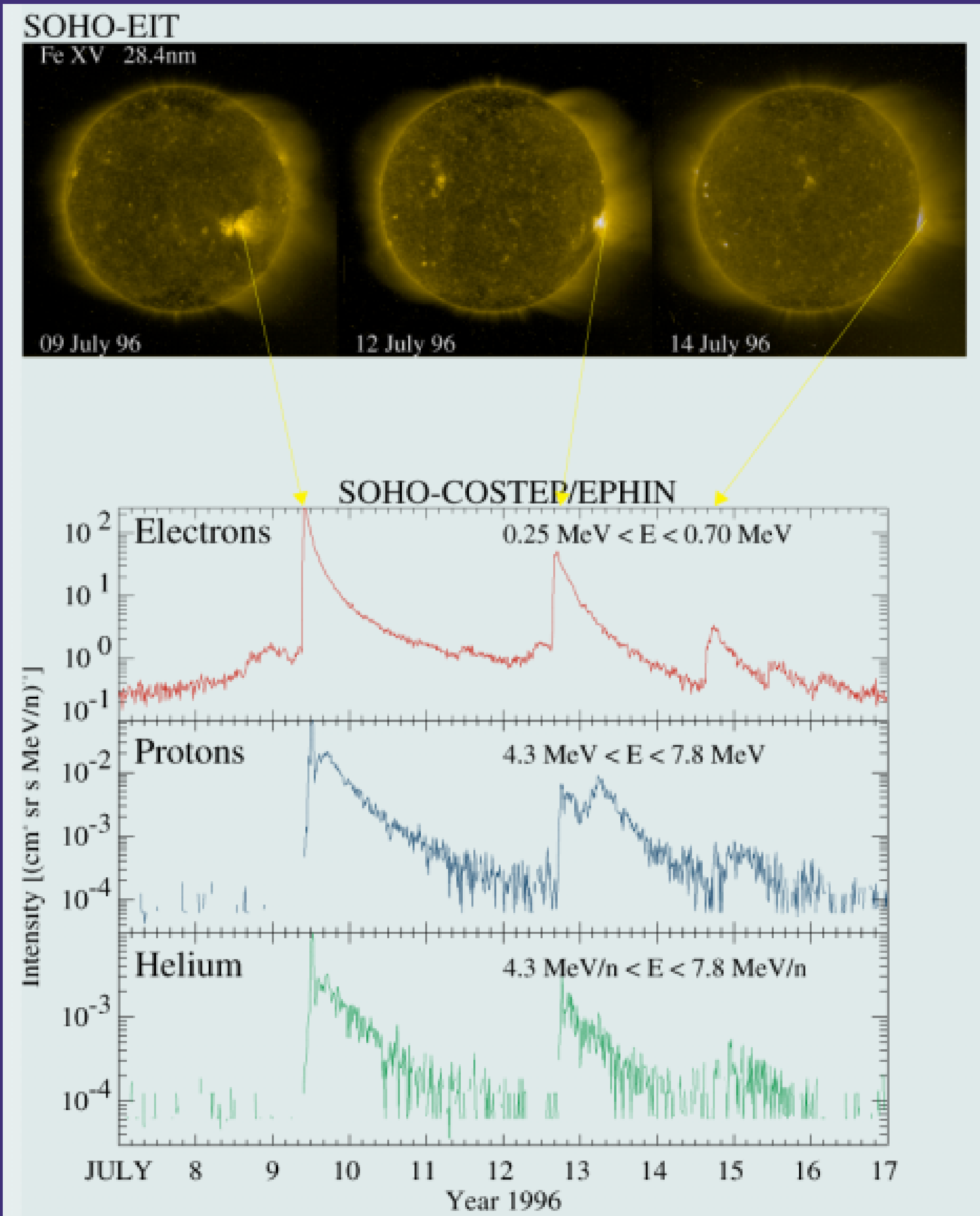
Radial and latitudinal variations of the sound speed in the Sun as derived from MDI and VIRGO measurements. Red = hotter regions than in standard model, blue = cooler regions.



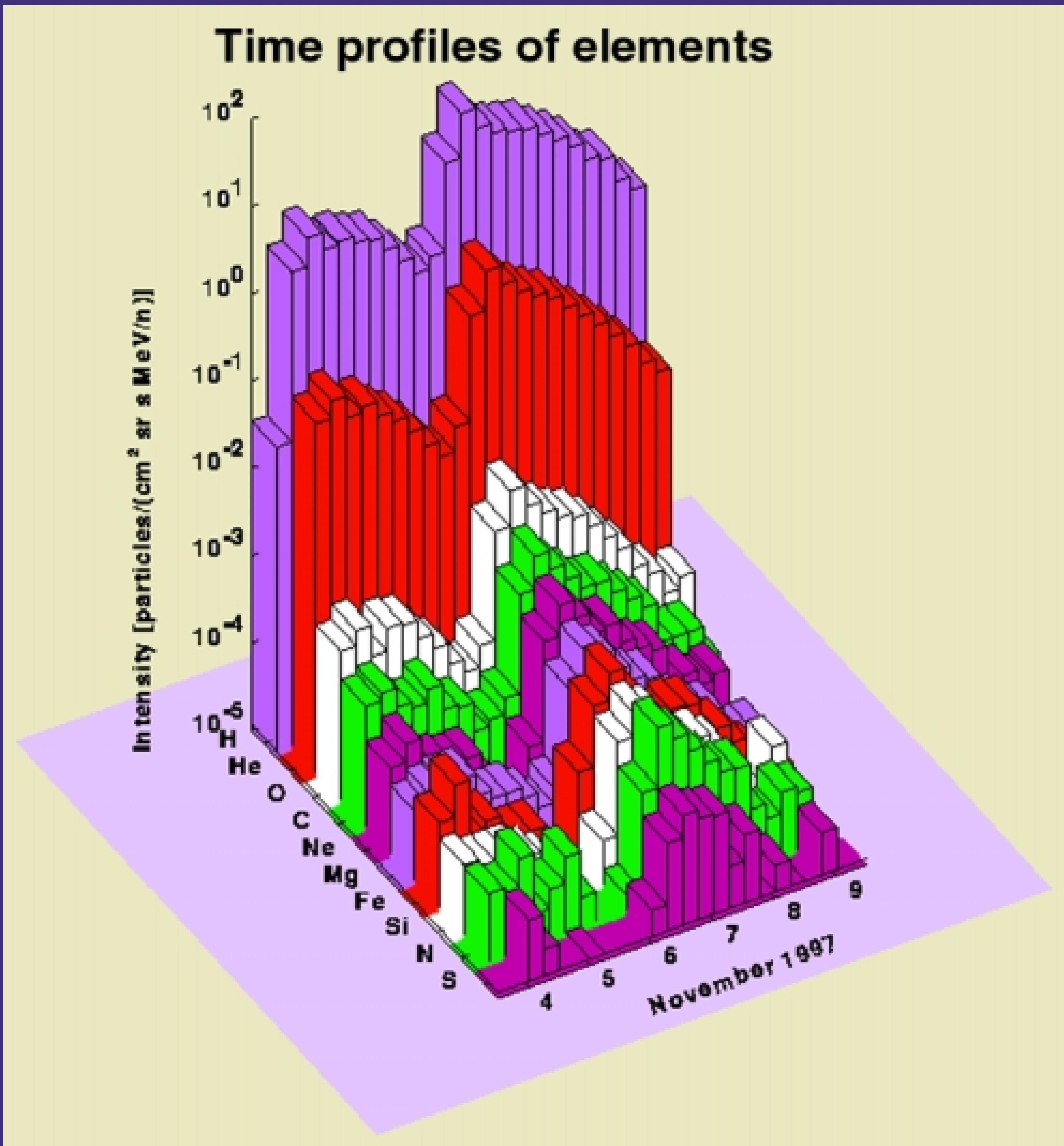
First image of the sub-surface temperatures and flows in the convection zone of a star deduced from MDI observations



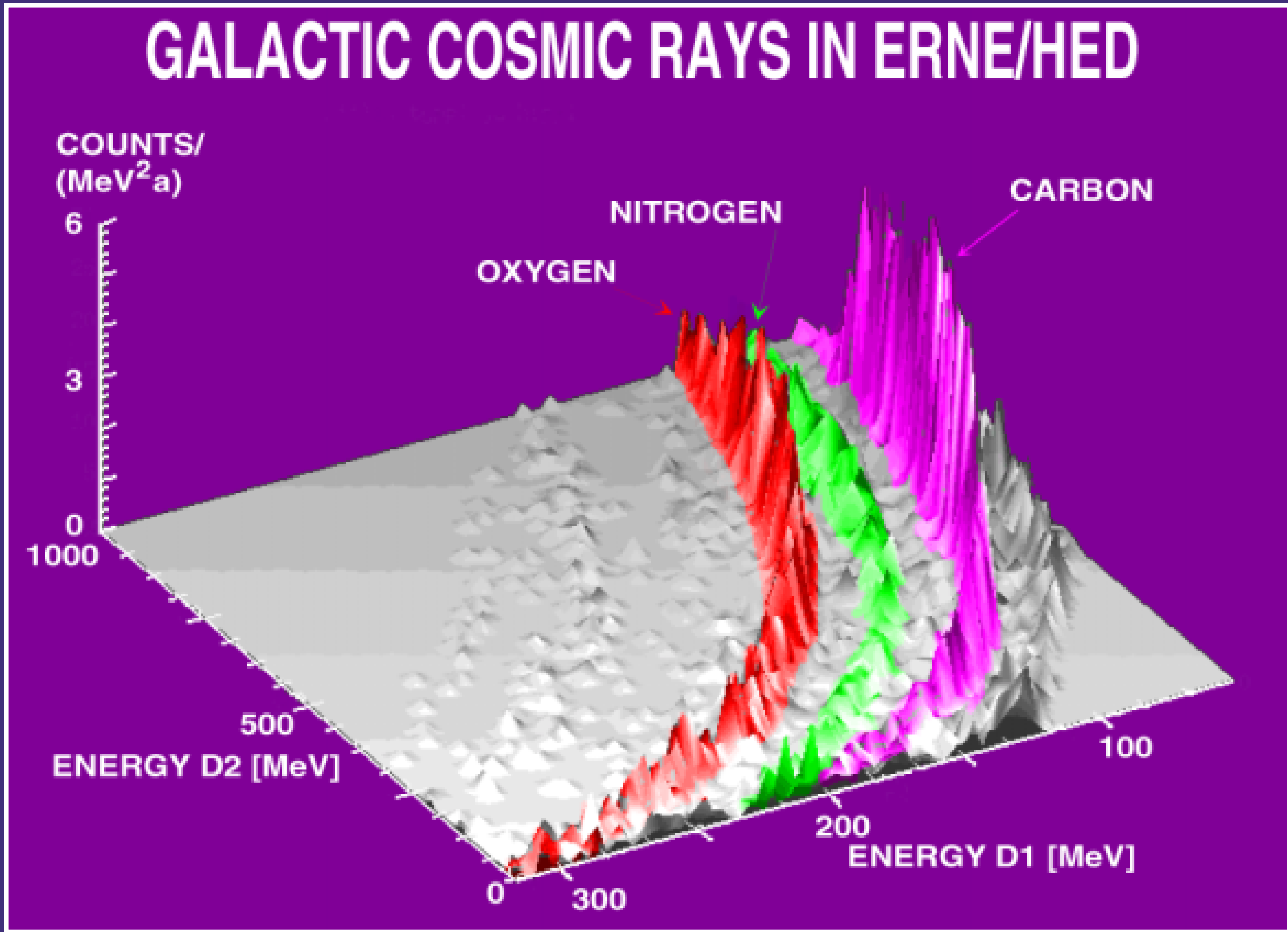
CELIAS chart showing new *(red)* and rarely observed *(green)* elements and isotopes discovered in the solar wind



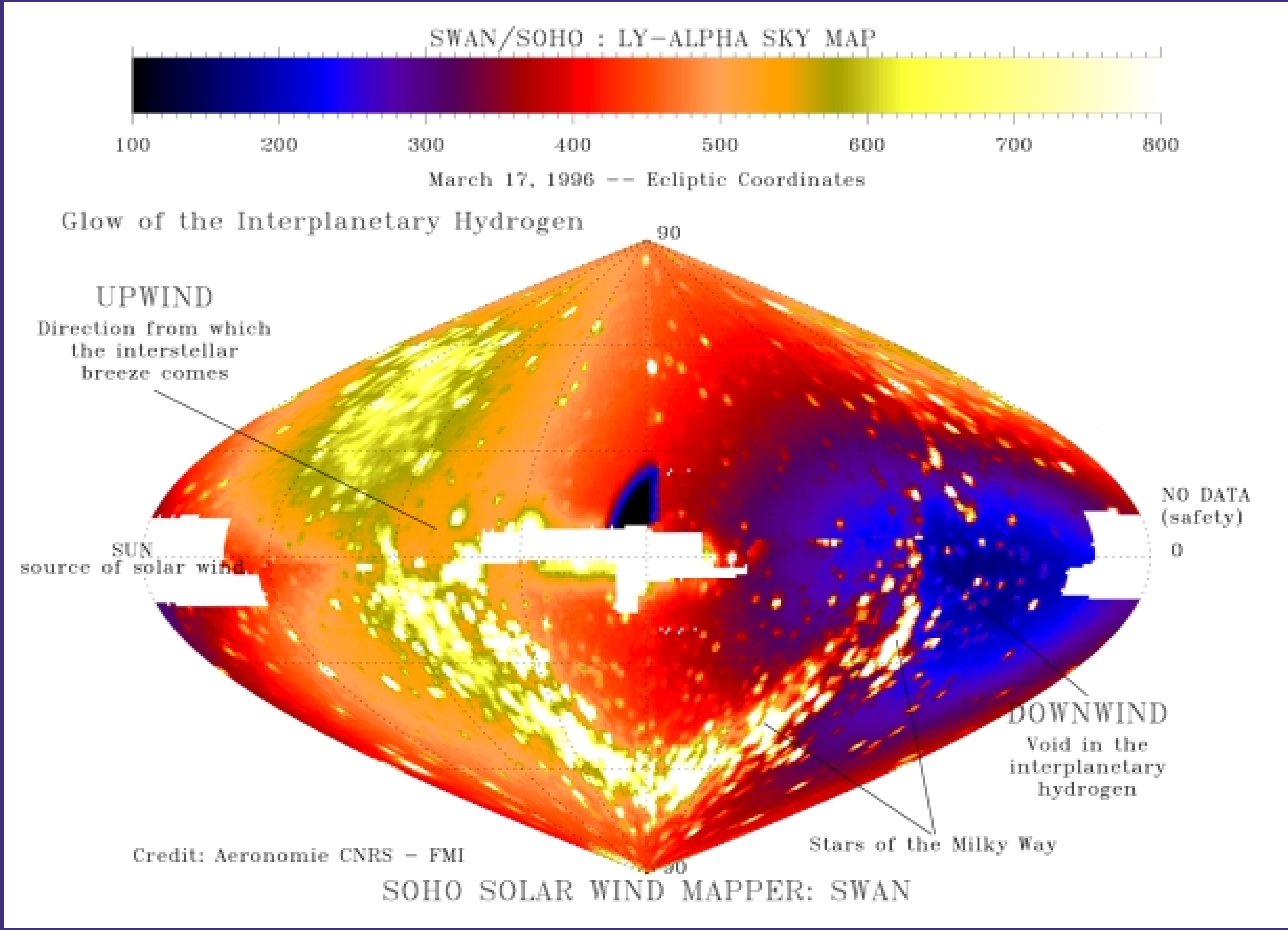
Series of solar energetic particle events observed in July 1996 by the COSTEP instrument



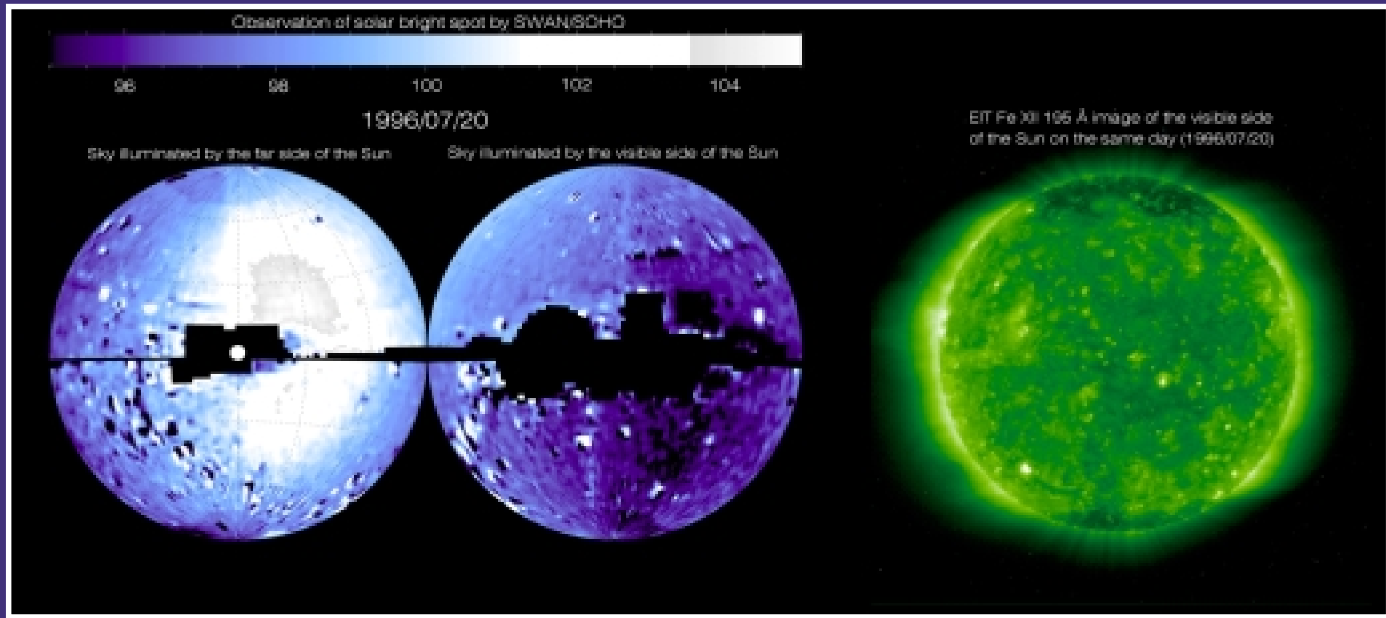
Time profile of elements during the flare event of 6 November 1997, as detected by the ERNE instrument



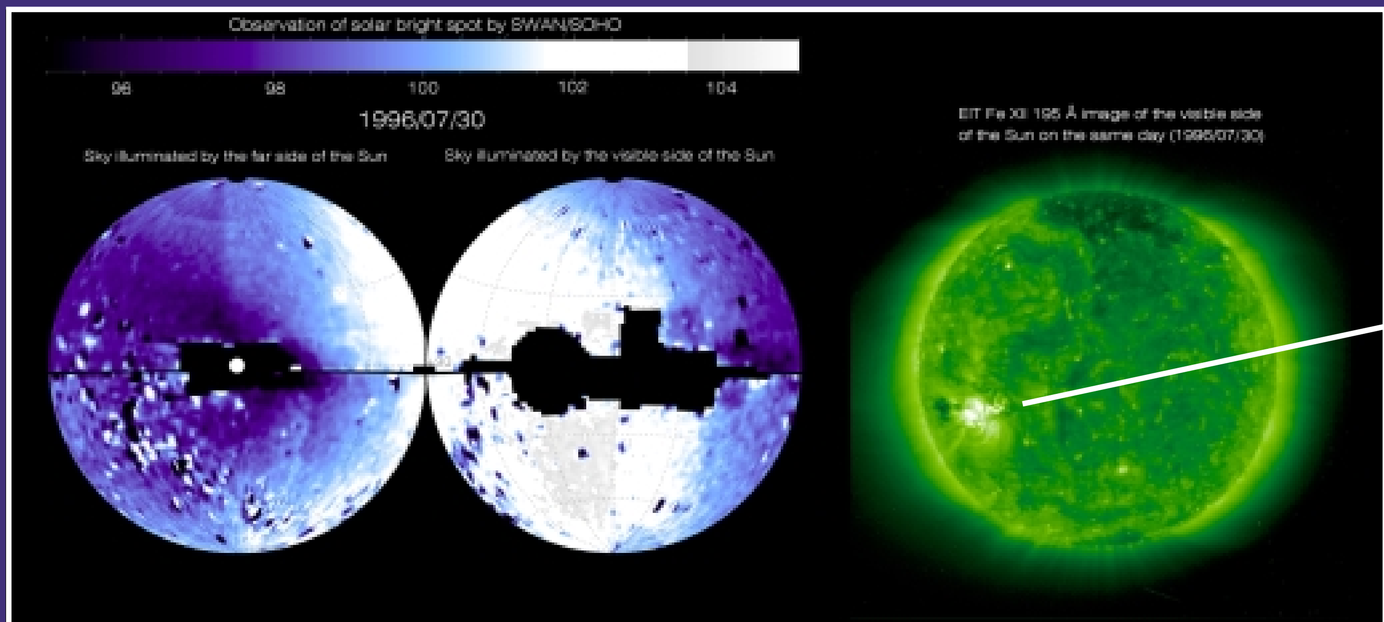
Galactic cosmic rays as recorded by ERNE. Galactic cosmic radiation consists of particles originating in the Milky Way



Lyman-α whole sky map as recorded by SWAN on 2 February 1996. The U-shaped yellow, bright band is the Milky Way.

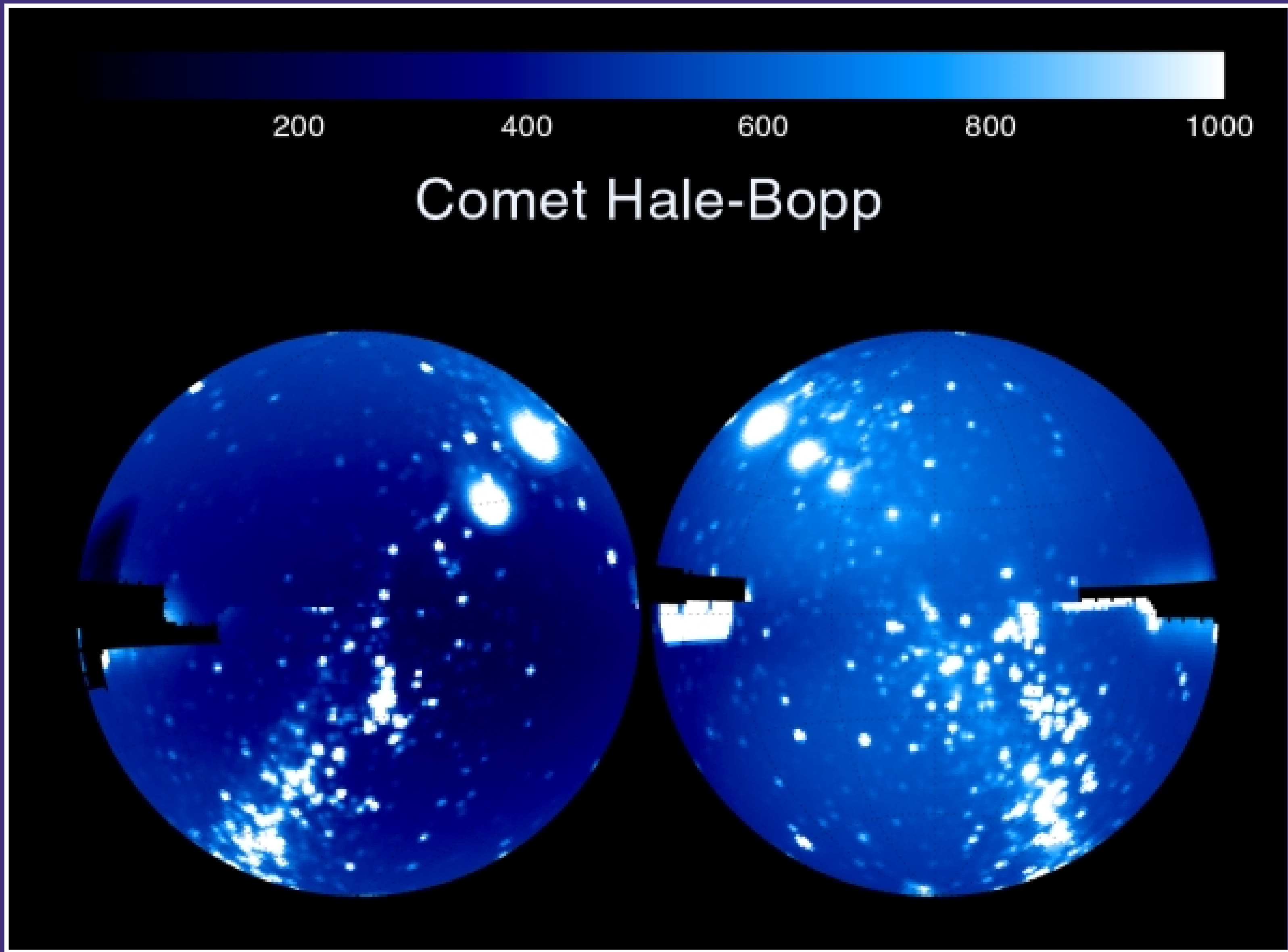


Active region on the far side

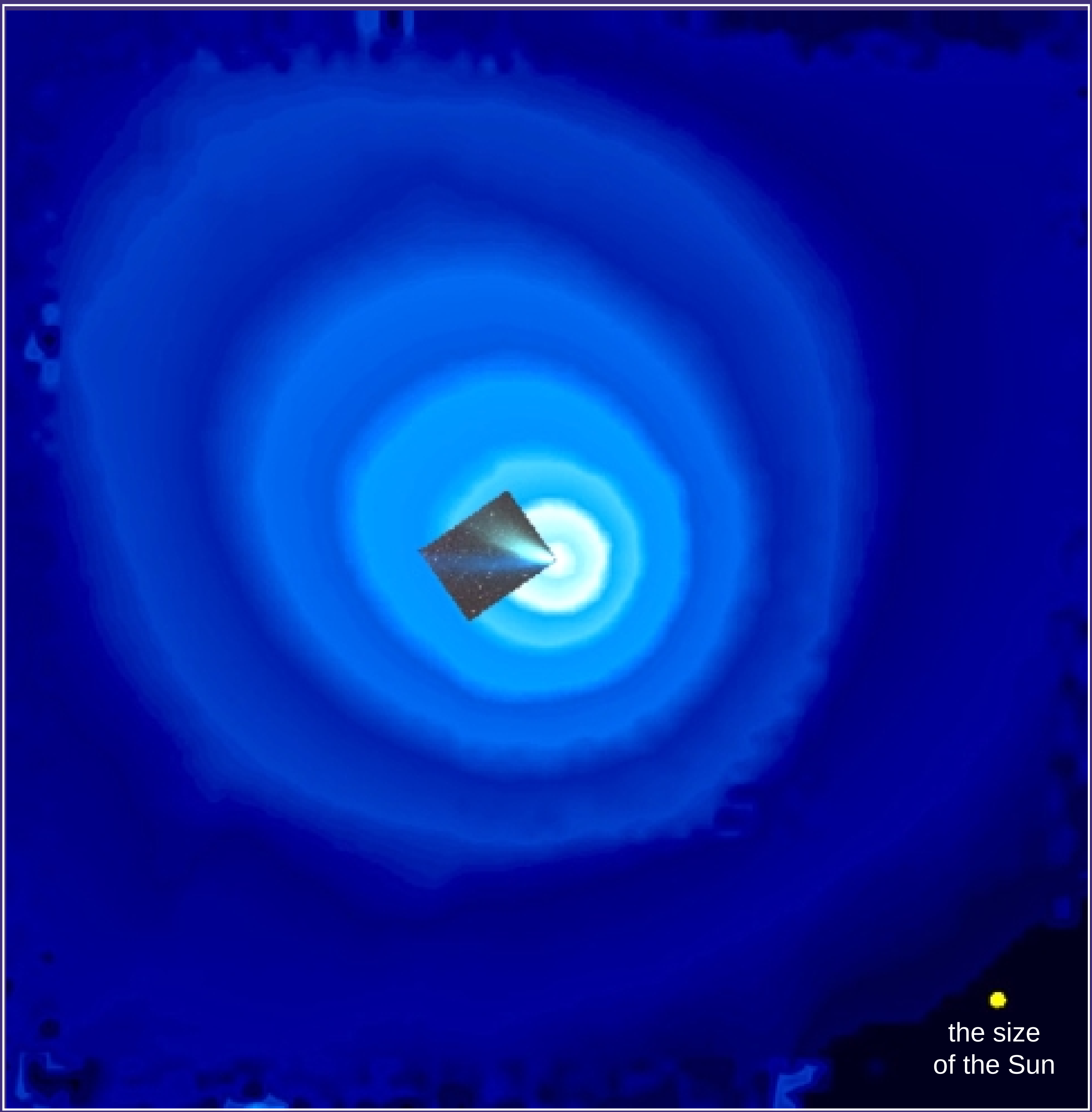


Active region now visible

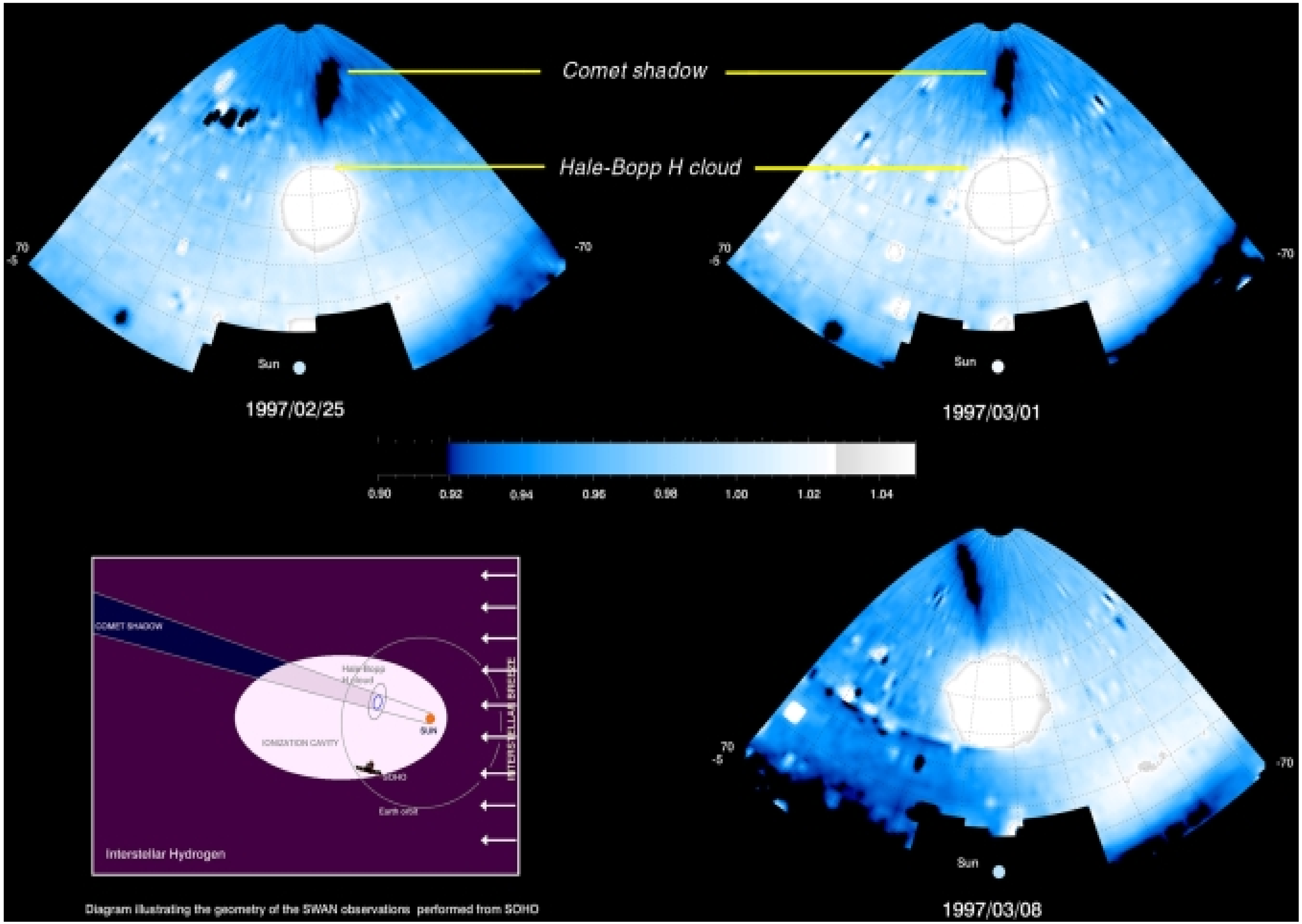
SWAN observation of active regions on the far side of the Sun. Active regions illuminate the distant interstellar hydrogen cloud like a searchlight strikes clouds at night.



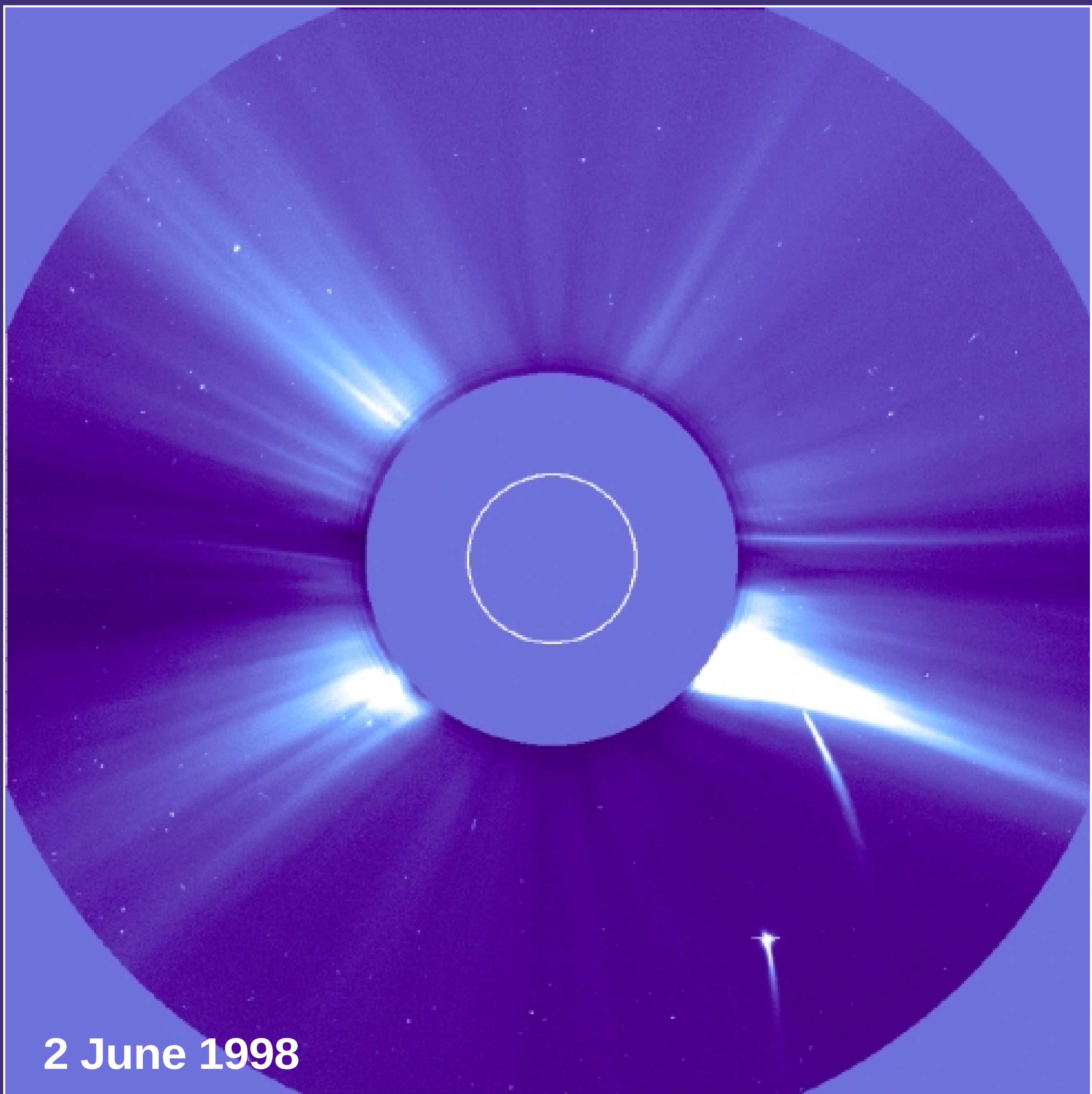
Comet Hale-Bopp seen approaching the Sun in a time series of six SWAN full sky images in the ultraviolet light (1100-1800 Å) from 4 January to 3 April 1997



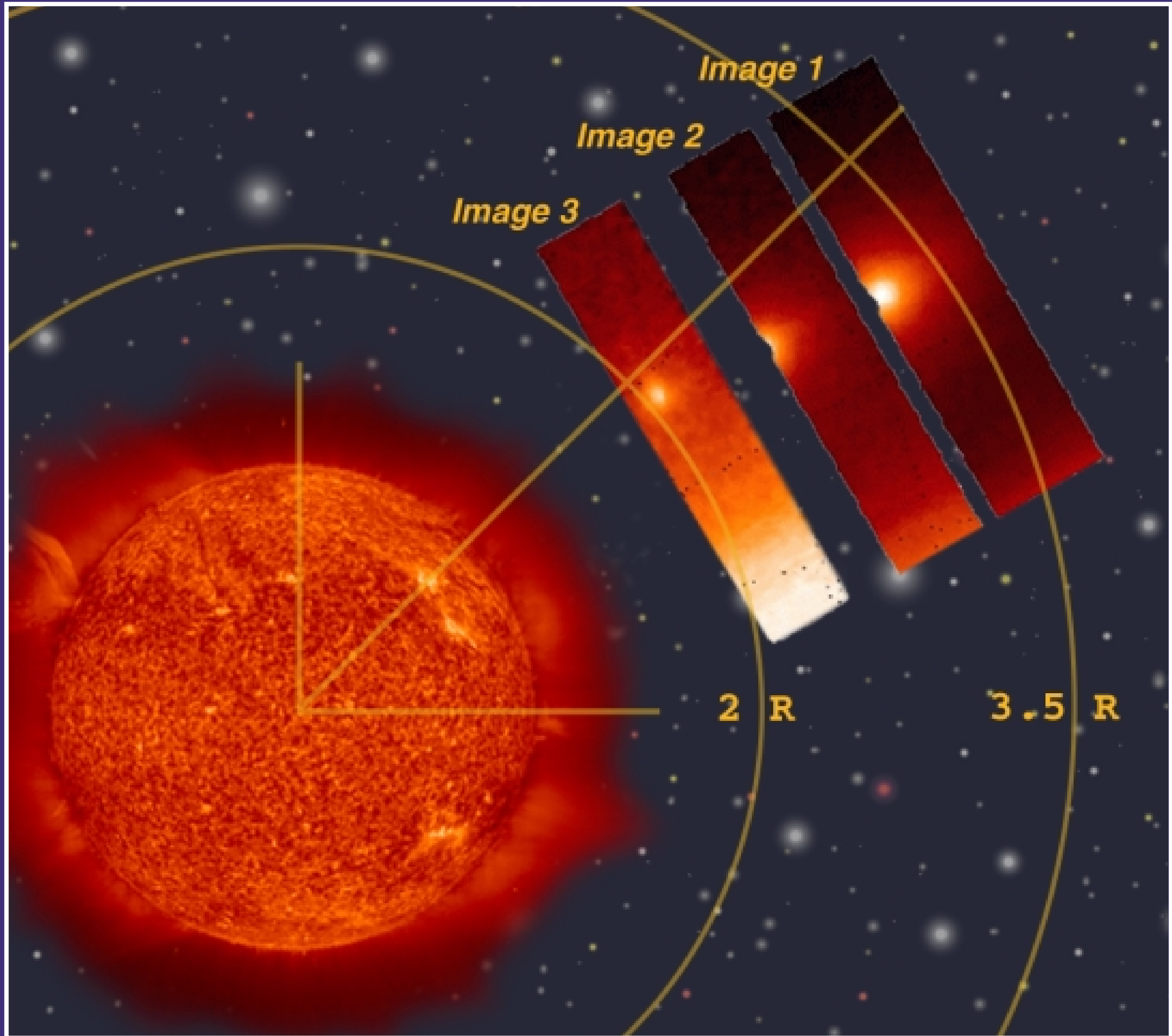
SWAN recording of the huge cloud of hydrogen, 70 times the size of the Sun, surrounding Comet Hale-Bopp when it neared the Sun in 1997. Ultraviolet light revealed a cloud 100 million kilometres wide and diminishing in intensity outwards (contour lines).



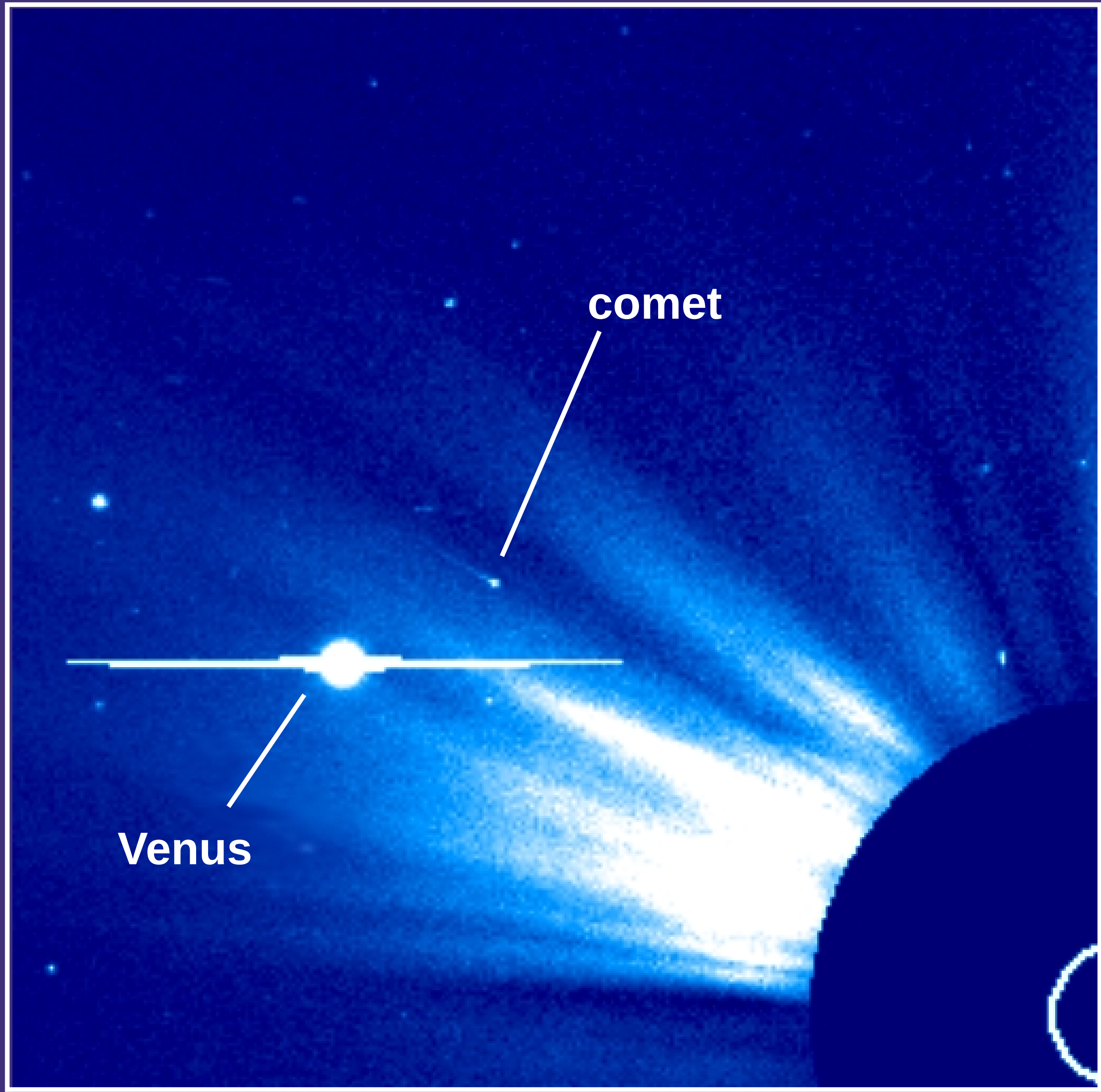
Observation of the shadow of Comet Hale-Bopp by SWAN



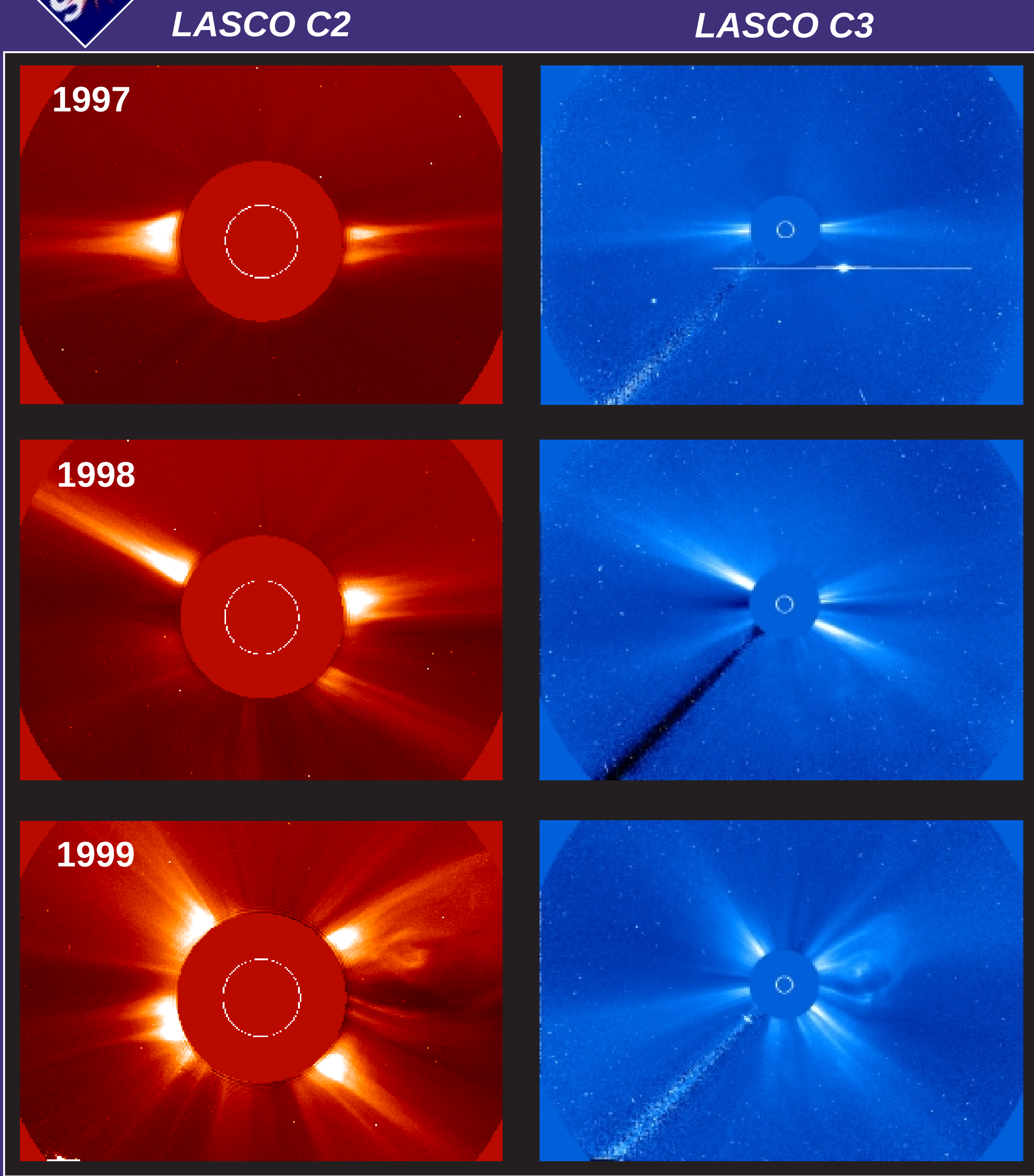
Two “Sungrazing” comets heading in tandem towards the Sun’s corona. They do not reappear on the other side.



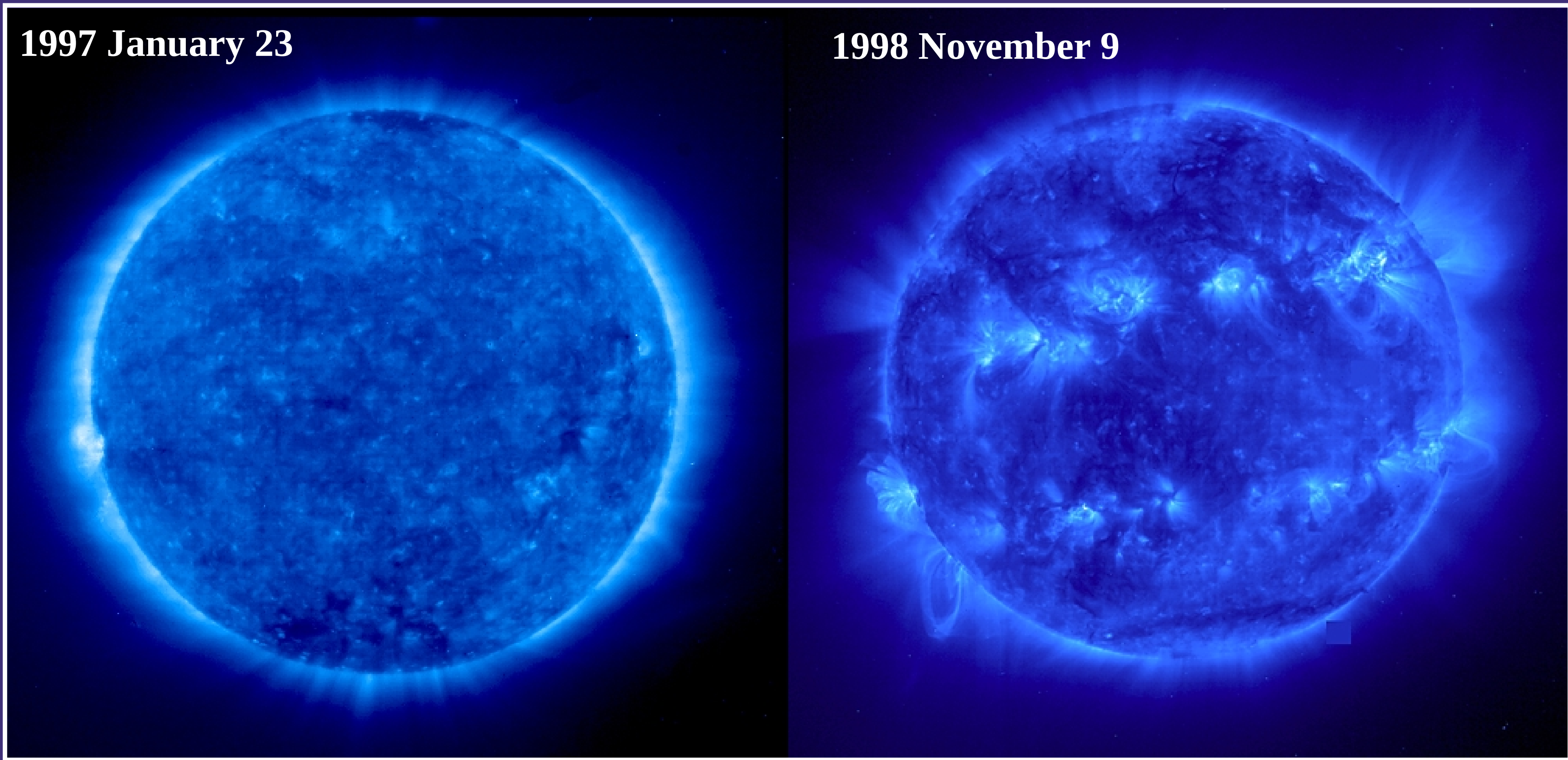
A comet observed by UVCS in Lyman alpha on 1-2 May 1997 as it approaches the Sun



Spectacular view of the solar corona with Venus and a sungrazing comet (SOHO 58) as observed by LASCO

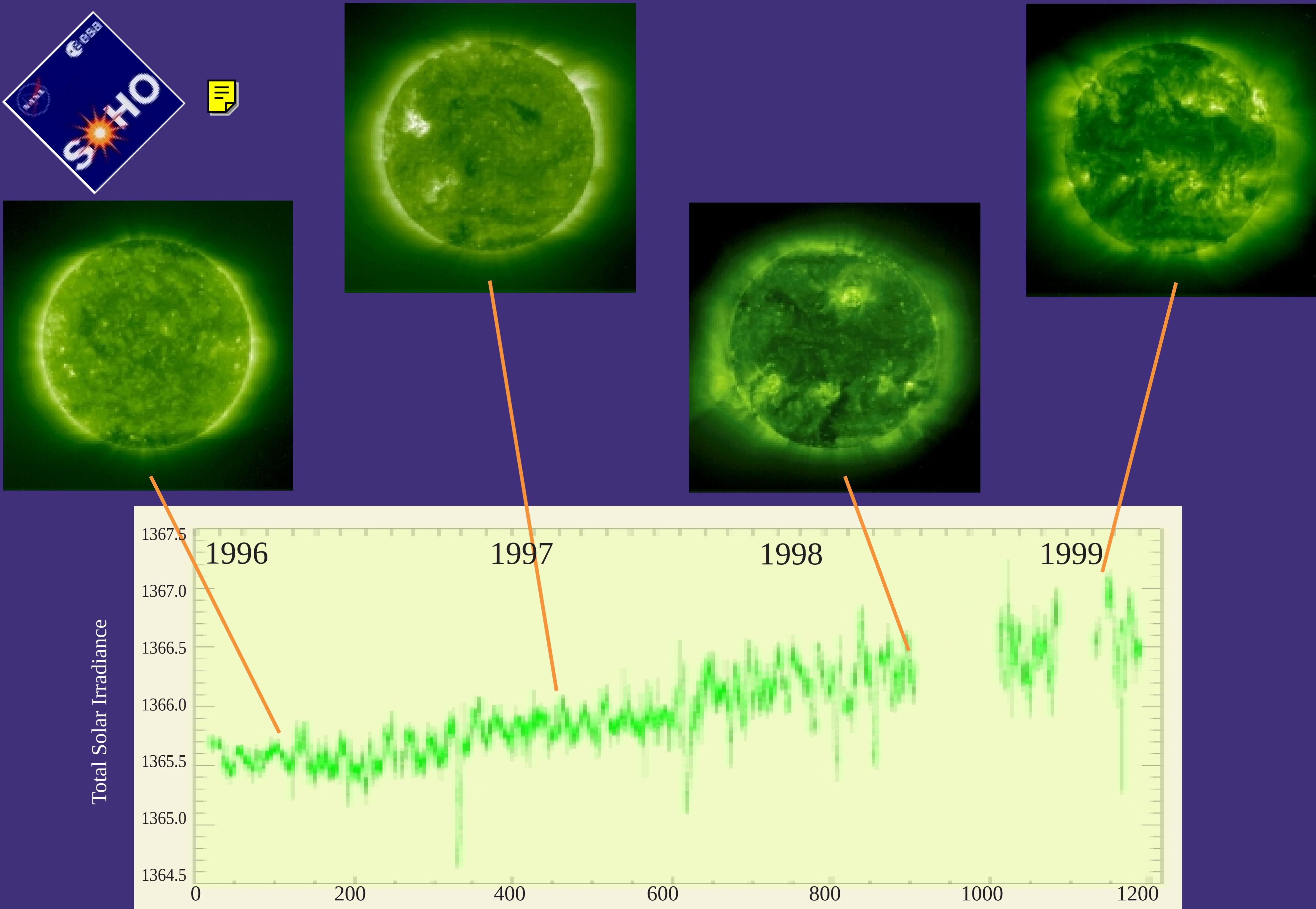


The changing shape and structure of the corona with the solar cycle

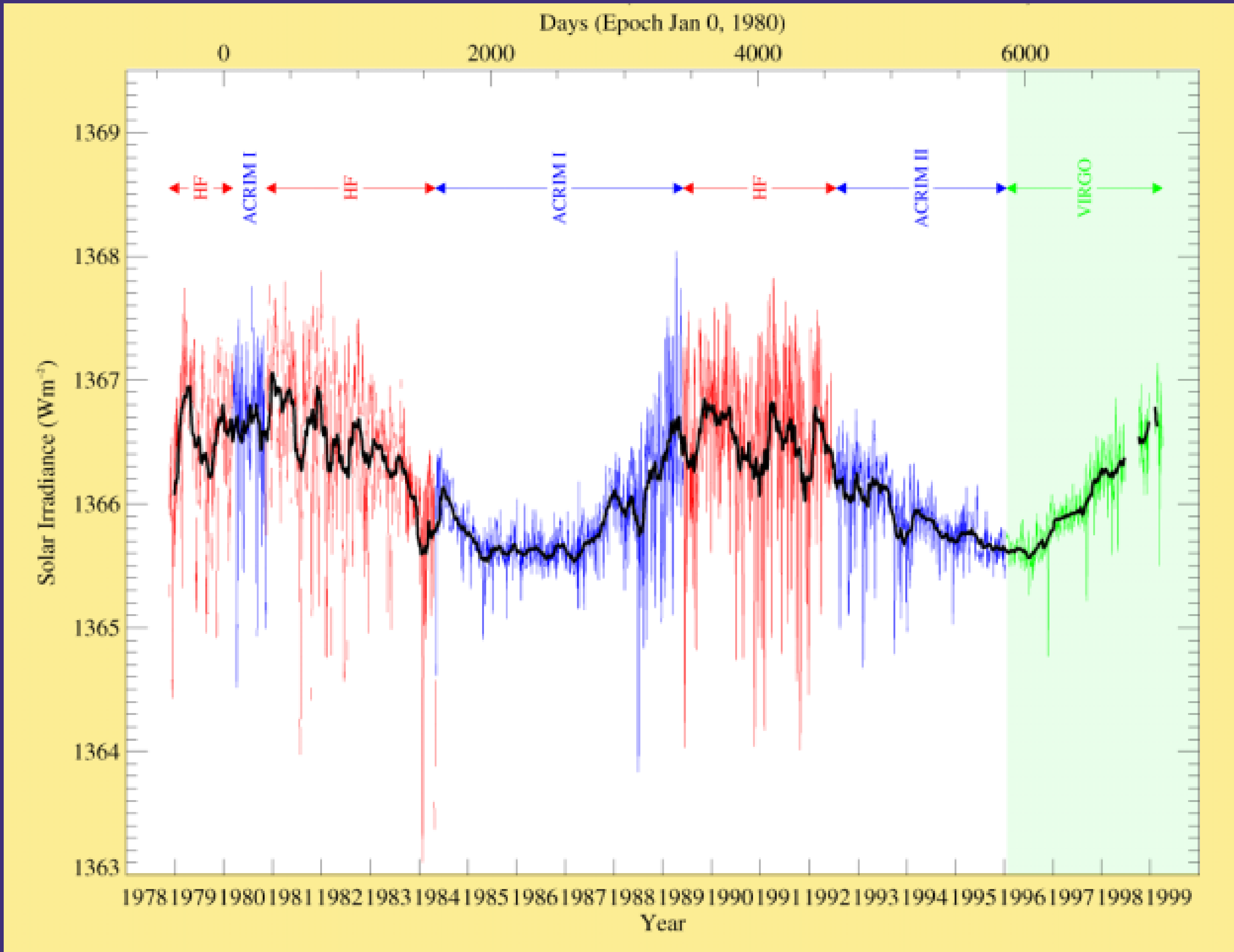


A comparison of two EIT images almost two years apart illustrates how the level of solar activity has increased significantly

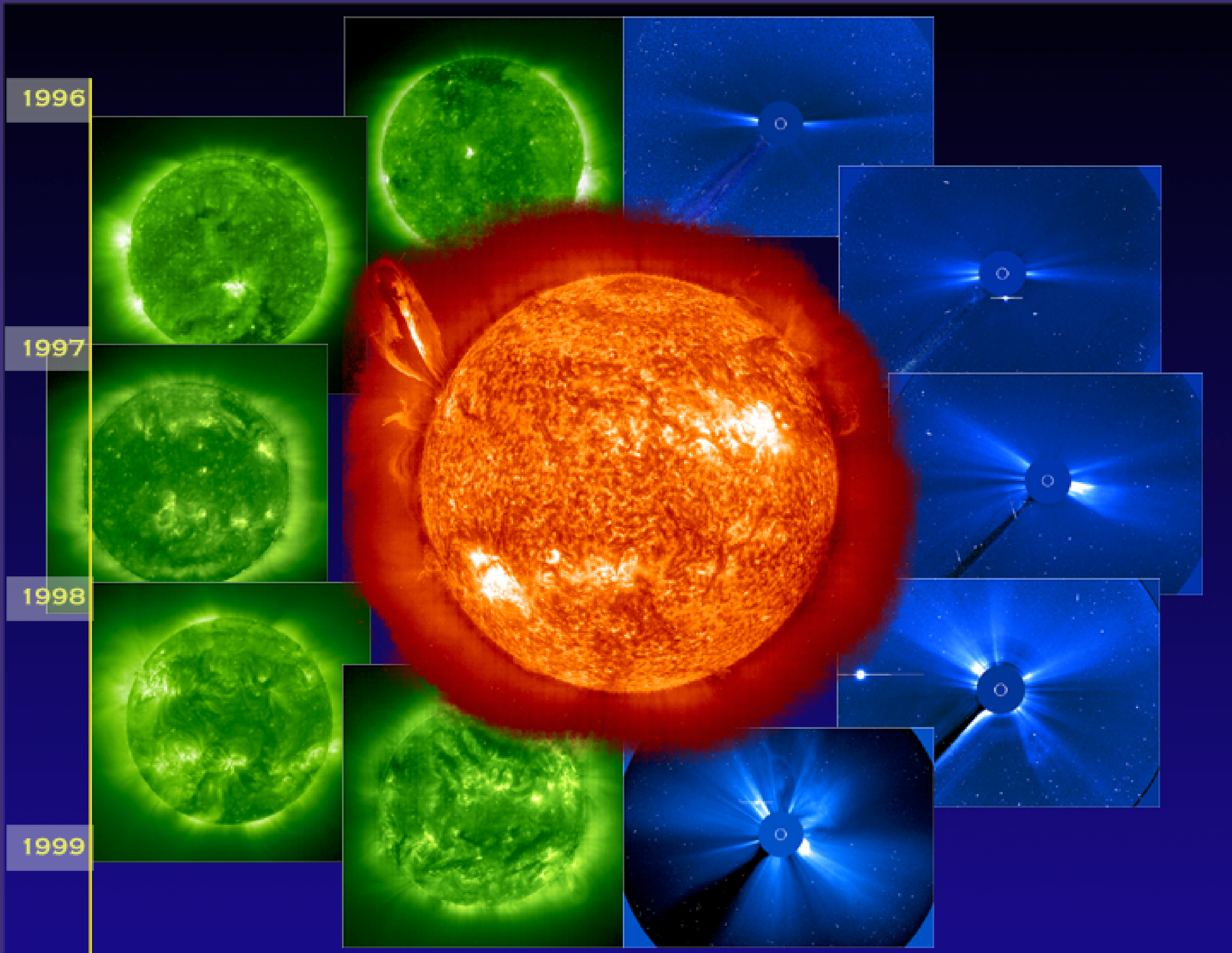
Images are Fe IX/X at 171 Å showing the solar corona at a temperature of about 1 million K.



Increasing total solar irradiance as measured by VIRGO since SOHO's launch. The EIT full disk images show a corresponding increase in solar activity.



Total irradiance variations during solar cycles 21–23 as recorded by several satellites since 1978. The data shaded in green is from the VIRGO instrument.



The gradual increase in solar activity as shown in the EIT and LASCO C3 images illustrates the approach of solar maximum